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ENCYCLOPEDIA OF CHEMICAL REACTIONS

COMPILED AND EDITED BY

C. A. JACOBSON

Professor of Chemistry, West Virginia University

VOLUME I

ALUMINUM

ANTIMONY

ARSENIC

BARIUM

BERYLLIUM

BISMUTH

BORON

BROMINE

REINHOLD PUBLISHING CORPORATION

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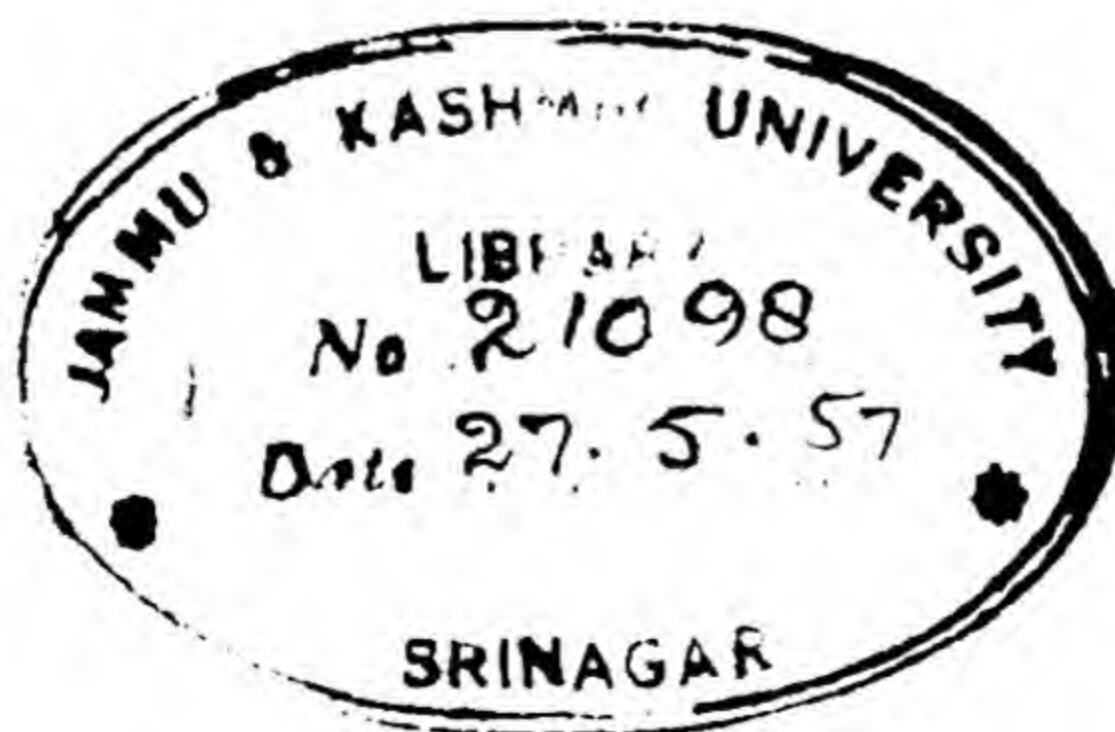
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Introduction

HISTORICAL

Conception of the Plan

In 1925 the Williams & Wilkins Company of Baltimore, Maryland, published a book for me entitled "A Pronouncing Chemical Formula Speller and Contest Guide," which contained about fifteen hundred chemical reactions expressed in equation form. These reactions embraced only elementary chemical transformations, and were especially designed to meet the needs of freshman students and others who were beginning the study of chemistry. Although the book referred to contained other features, its popularity was essentially due to the section on chemical reactions.

The frequent use to which this book was put led me to envisage a complete reaction book or set of books that would contain all, or practically all, the published chemical reactions, described briefly and expressed in equation form. It has taken twelve years for this air castle to begin to assume material form. I was told by many that it was too great an undertaking.

The plan was discussed with Dr. E. W. Washburn, formerly of the Bureau of Standards, Washington, D. C., who had completed the "International Critical Tables" a short time before. No one was better able to judge the tremendous amount of work involved in producing an encyclopedia of this sort than he, but he told me it was not impossible if sufficient help could be secured to go through the literature.

Funds were not available to employ abstractors for reviewing the chemical journals and consequently the plan would have to be abandoned unless I could secure volunteer abstractors who would think enough of the project to donate their time to get the work under way.

Cooperation from Editors of Scientific Periodicals

A prospectus of the plan was drawn up and submitted to Dr. Otto Reinmuth, then Editor of the *Journal of Chemical Education*, for his evaluation and comments. The idea impressed him sufficiently not only to give a prominent place in his journal (Vol. 10, 1933) for the article, "A Proposed Encyclopedia of Chemical Reactions", but also to head it with the following editorial note:

"Despite the excellent abstracting service available to us and the reference compilations to be found in all well-equipped chemical libraries, the labor of making a reasonably thorough search of the literature pertaining to even a very limited field of chemical subject matter is tremendous. A truly exhaustive search is seldom attempted

and probably represents in reality only an ideal to be approached as closely as possible.

"The usual literature search may be roughly divided into four stages: (1) accumulation from reference works of a summary of facts with corresponding references for subsequent checking and amplification by direct resort to the literature; (2) extension of the original summary by search of abstract indices; (3) examination of abstracts to determine which references are worthy of fuller investigation; (4) verification of facts and references already accepted as useful and supplementation of summaries by direct resort to the literature.

"It is obvious that if any of these processes could be performed more efficiently or if any two of them could be combined, library research would be significantly facilitated. A work of the type proposed by Dr. Jacobson would combine the convenience of an index with a considerable portion of the informational content of abstract and reference works."

Dr. J. McKen Cattell published in *Science* for June 15, 1934, an article entitled "An Encyclopedia of Chemical Reactions" and has since then released notes about the progress of this work.

To the above editors as well as to the late Dr. Harrison E. Howe, Editor of *Industrial and Engineering Chemistry*, and to Mr. Watson Davis, Editor of the *Science News Letter* must be given much credit for letting people know about the proposed undertaking, without whose cooperation it would have been impossible to proceed. Foreign publications, such as the *Journal of the Society of Chemical Industry*, *Journal of Canadian Chemistry and Metallurgy*, *Journal of the Indian Chemical Society*, *Chemicky Obzor*, etc. have published notices about the Encyclopedia.

Personnel

After explaining the aim of the E.C.R. to some graduate students in the Department of Chemistry of the West Virginia University, the first volunteer to apply the plan to a search of chemical literature as a topic for the Master's thesis was Miss Kathryn Huffman, who started the work of recording, under each element, the conditions governing the chemical reaction between a given compound and another element or compound called a reagent, and then expressing that reaction in the form of an equation. Such literature search proved of considerable didactic value.

Miss Mary B. Larcher and Mr. Carl Armour also abstracted assigned sections of chemical literature, equivalent to the requirements for their Master's theses.

In addition to the above-mentioned work, Miss Huffman was employed on a special University fund to do abstracting for the E.C.R. during an

entire summer vacation. Dr. Virgil Lilly was likewise employed to abstract German chemical literature during the summer months.

Other graduate students who accepted assignments to do abstracting work are: P. S. Potesta, Benjamin Tatterson, John Russell, David Posten, and later, Dorothy Franz, Lawrence T. Johnson, Herman A. Reda, Ralph E. Wilmer, and Owen C. Greenwell.

After the publication of the above-mentioned articles many inquiries about the project and promises of support were received, but the most valuable one for the E.C.R. was from Prof. Wilhelm Segerblom of Exeter, New Hampshire. He wrote me as follows:

"Your account of a proposed 'Encyclopedia of Chemical Reactions,' as printed in the *Journal of Chemical Education* for October 1933 has interested me much. When I think of the hours that were spent, the volumes that were consulted, and the leaves that were turned in the preparation of my own little book on 'Properties of Inorganic Substances', I stand aghast at the magnitude of the undertaking you are proposing. But when I think of the time and effort that your encyclopedia will save chemists in future years, then I realize that the results more than warrant the effort. The sooner you get the book compiled and published the better for the progress of Chemistry."

This friend of the E.C.R. took hold of the abstracting of the Scandinavian chemical journals in dead earnest and covered practically all of them found in this country, spending his entire vacations for four years in the libraries of the universities of Harvard, Yale, Columbia and Madison. He also spent some weeks at the Library of Congress, all at his own expense. Unfortunately, Professor Segerblom did not live to see the fruit of his enormous labor, but as a deserved memorial to his devotion I want to inscribe his name at the very top of the list of associate editors of the "Encyclopedia of Chemical Reactions." He contributed freely and without stint to a cause that he considered of lasting importance.

Professor Thomas W. Davis of New York University also wrote me at an early date expressing his convictions about the need and usefulness of a work like the E.C.R. in the following terms:

"There is a continuing need for such a compendium, a need which is not lessened by industrial and economic crises. Its success will depend on the loyal efforts of a corps of abstractors and compilers—each making a small sacrifice of time and energy in the interest of the common undertaking. The general prospectus is sound—we need now the detailed work of following it through. When the 'Encyclopedia' is finally issued, I am sure that it will at once be accepted into the literature as an indispensable reference work. Its place is not filled by descriptive treatises on inorganic chemistry—there can be no adequate

substitute for it. We shall see the truth of this statement more clearly after the 'Encyclopedia' has been used a short time. I am happy to be able to contribute in a small way to its final success."

The roster of abstractors for the E.C.R. numbered only 31 up to December 1940. Shortly after that date notices about the progress of the E.C.R. were published in the *News Edition of Industrial and Engineering Chemistry*, in the *Journal of Chemical Education* and in *Science*, which revived an interest in the work, so that in December of the following year (1941) there were 103 listed abstractors. Although perhaps less than half of them had shown very little or no interest in doing any abstracting, yet the sum total of all reactions submitted up to that time was 12,768.

The interest in the E.C.R. continued to spread until on June 1, 1942, the abstractor personnel numbered 116 and the total reactions submitted to that date was 15,863.

On July 1 of that year we began assembling the reactions under aluminum, antimony, and arsenic with a view of putting these in condition for publication in the first volume. There were found to be 659 under Al, 372 under Sb, and 1021 under As.

TESTIMONIALS

The value of any work or publication is determined by the consensus of opinion of people interested along a similar line. Before chemists in general will take seriously a work like this, it is natural that they should inquire what other chemists think about it. For this reason it was thought advisable to include, in the introduction, a brief section of opinions contributed by chemists in different fields of the profession. The original letters containing these statements are on file, and are reproduced without regard to any order of importance.

Prof. Ralph E. Dunbar, Dean of the School of Chemical Technology, Fargo, N. Dak. says:

"Busy chemists will recognize the value and importance of having the inorganic chemical literature systematically and conveniently abstracted. This is the first consistent effort to assemble all available inorganic reactions into one complete and comprehensive work. The saving in time and effort on the part of research workers will more than compensate for the combined activities of all faithful abstractors who have cooperated in the compilation of these volumes. The specific references to the original chemical literature of the world will be an important lead to those workers who desire more detailed information regarding any reaction. Even ambitious students may find here the answer to many perplexing problems. Perhaps it is not too ambitious an ideal to hope that the 'Encyclopedia of Chemical Reactions' may

eventually find its place along with the 'International Critical Tables,' Mellor's 'Comprehensive Treatise on Inorganic Chemistry,' Abegg-Auerbach's 'Handbuch der Anorganischen Chemie,' and Beilstein's 'Handbuch der Organischen Chemie,' as an essential addition to all industrial and educational research libraries. At least such is our hope."

Dr. Paul A. Giguère, Assistant Professor of Chemistry, Laval University, Quebec, Canada, says:

"While it is obvious that such a work as the E.C.R. will be useful to all chemists in general, it seems that it will prove of exceptional assistance in research work. Indeed, not only will this encyclopedia provide a complete and adequate source of information regarding the numerous inorganic compounds already described in the literature, but it will further contribute to the progress of chemistry by offering a concise picture of what is left to be done, for instance on such topics as the molecular structure and properties of the various compounds, their methods of preparation, the mechanism of the reactions in which they take part, etc. A simple glance through the book should not fail to suggest scores of interesting problems, as yet unsolved."

Dr. Walter Wagner, Assistant Professor of Chemistry, Worcester Polytechnic Institute, Worcester, Mass., says:

"Many chemists engaged in research, teaching or technical laboratory work will find the need for a work containing all hitherto published chemical reactions in available form. The vast amount of material presented in this comprehensive list is invaluable to them."

"Of particular value, it seems to me, is the perpetuity feature of the work, permitting the scholar to follow the most recent achievements in chemistry. At the same time it enables him to pursue the historic development of certain reactions in which he is interested."

"After all, I feel certain that this outstanding work will become a reliable and even indispensable companion of everyone engaged in chemistry."

Dr. G. E. F. Lundell, Chief Chemist of the Bureau of Standards, Washington, D. C. wrote me the following several years ago:

"When you first discussed the matter with me I was somewhat dubious of the plan, chiefly on account of the enormous amount of work that would be necessary if the compilation were to be anywhere near complete. I now believe that it is feasible and that it would be a tremendous help to the chemist, particularly to the analytical chemist."

Mr. James A. Austin, Chairman, Kansas City Section A.C.S., Kansas City, Mo., says:

"The recorded observations of the reactions of the elements are scattered throughout the vast literature of chemistry and many that

may have potential value, either academic or economic, lie buried in this mass.

"It is the purpose of this publication to bring together these observations in one work with the hope that, from it, workers may receive inspiration for further research leading to a better knowledge of the fundamental nature of chemistry and also to the utilization of some of these reactions in present day problems.

"The intense interest in micro or semi-micro technic, especially as applied to qualitative analysis, has developed rapidly in the past few years and the search for methods of producing materials which were formerly imported are just two reasons for supporting this compilation of reactions of the elements.

"If these pages lead to just one single application toward these ends, the contributors will feel amply repaid for their efforts."

Mr. E. J. Crane, Editor of *Chemical Abstracts*, Columbus, Ohio, wrote in 1933:

"I have read your article descriptive of the proposed 'Encyclopedia of Chemical Reactions' and have thought about it a good deal: Such a compilation would serve as a handy tool for chemists and it certainly would be fine if some magician could wave a wand and a completed copy would drop into the hands of each of us."

Dr. Frederick C. Nachod, Research chemist, Permutit Company, res. Mt. Holly, N. J., says:

"Chemists realized very early the need for standard works of reference to coordinate and check on old and new findings. A chemist nowadays would feel lost without *Chemical Abstracts*, *Chemisches Zentralblatt*, etc. Such reference works had to be supplemented by others of a different nature like Landolt-Bernstein's 'Tabellen,' Gmelin-Kraut, Mellor's treatise, etc., but up to now we have no complete handbook summarizing the chemical reactions which are encountered in the literature. This gap is now to be filled by the Encyclopedia of Chemical Reactions. There will probably be many criticisms and suggestions before the E.C.R. reaches its final form, but we hope that it may grow quickly and steadily in order to become an essential tool for the chemist of today and tomorrow."

Many other excellent testimonials are at hand equally worthy of inclusion in this section, but lack of space prevents.

NOMENCLATURE

No doubt greater variations in both the spoken and written language of chemistry may be found than in the language of any other science. These variations exist not only in pronunciation but in the spelling and hyphenating of words and in the writing of formulas. The American Chemical

Society have a standing committee whose efforts have been directed, over a long period of years, to the standardization of nomenclature, spelling and pronunciation of chemical words and the writing of formulas, but the impression made upon the body of chemists as a whole leaves much to be desired.

This subject might properly be introduced by saying that there is still confusion in the chemical trade due to the fact that manufacturers of chemicals are slow to follow the advances made in chemical nomenclature. A few illustrations are doubtless apropos: Should we desire to buy some sodium fluosilicate we must ask for sodium silicofluoride; if we need boron trioxide we must specify acid boric. White arsenic or arsenic trioxide is sold under the name "acid arsenious." Suppose we are in need of some sodium dihydrogen orthophosphate; we find listed in the chemical catalogs "sodium phosphate, primary, secondary, and tertiary." The beginner in chemistry would have to consult his dictionary before he could order the right chemical. When we buy periodic acid we receive H_5IO_6 instead of HIO_4 . In other words, there is no indication in the catalog that the substance offered for sale is the dihydrated acid. Should we wish to purchase some vanadium trichloride, we find listed "vanadium chloride, dry, liquid, or sirupy." Vanadium occurs as either the di-, tri-, or tetrachloride, and we have no direct way of telling if the manufacturer or agent has what is wanted.

Both VOSO_4 and $\text{V}_2\text{O}_2(\text{SO}_4)_3$ are called vanadium oxysulfate or vanadyl sulfate. We have arbitrarily named the former vanadyl sulfate and the latter divanadyl trisulfate. HgNH_2Cl has been called ammono basic mercuric chloride; mercury amido chloride, amino mercury chloride and mercury II ammonium chloride. We favor mercury amido chloride. HN_3 is known as hydrazoic acid, azoimide or hydrogen azide. We favor triazoic acid, and triazides for its salts.

Enough has been said to show that there is still an enormous amount of work to do for a committee on chemical nomenclature.

In the present volume the editors have tried to follow as closely as possible the recommendations made by the Committee for the Reform of Inorganic Chemical Nomenclature of the International Union of Chemistry, issued in 1940.

Some of the exceptions and the reasons therefore may be listed as follows:

"The *ous* and *ic* endings for the copper and iron salts are retained because they have been very firmly established, and there is no ambiguity about them, so that we call $\text{Fe}(\text{CNS})_3$ ferric thiocyanate instead of iron III thiocyanate as given in the report.

For the same reason we also retained the common names of the acid salts of carbonic, sulfurous, and sulfuric acids, so that NaHCO_3 , NaHSO_3 , NaHSO_4 , and KHCO_3 , KHSO_3 , and KHSO_4 have been named sodium

bicarbonate, sodium bisulfite, etc. All other acid salts like Na_2HPO_4 , disodium hydrogen orthophosphate, have been named according to the Committee's recommendation.

Whenever an inorganic element in the formula of a salt was separated from the acid radical by oxygen, as for example BiONO_3 , the ending *yl* of the name has been adopted, so that this salt is called bismuthyl nitrate. Whenever this system might cause ambiguity, the term *oxy* has been used. Consequently, $\text{UO}_2(\text{NO}_3)_2$ was called uranium dioxydinitrate. The names recommended by the Committee for $\text{K}_4\text{Fe}(\text{CN})_6$ and $\text{K}_3\text{Fe}(\text{CN})_6$, potassium hexacyanoferrate II and potassium hexacyanoferrate III, have not been used, since the departure from the common names seemed too revolutionary. However, the Committee's names are very explicit, though long.

Ammonia addition compounds have all been treated alike and called ammoniates, just as water addition compounds have all been called hydrates, using the proper Greek prefix to designate the number of each addition product. Dr. E. C. Franklin, formerly of Leland Stanford Junior University made these compounds his life work, and was very positive in calling them all ammoniates. Conditionally the "Committee" also sanctions this usage. In representing the ammoniates by formulas we have inserted the NH_3 radicals at the end of the formulas exactly as is done with H_2O in hydrates. This is done for the sake of clearness of representation, and not with any regard to linkage of NH_3 radicals in the molecule when the compound is ionized or electrolyzed. For example, if we found the compound $\text{Cr}(\text{NH}_3)_6\text{Cl}_3$ described in the literature the formula entered in the equation was $\text{CrCl}_3 \cdot 6\text{NH}_3$ and the name given to it, chromium III chloride hexammoniate. Some writers do not drop the *a* in *hexa* and write the name hexaammoniate, but the former is more euphonious and its meaning cannot be misunderstood.

The name "stibine" is used interchangeably in the literature for SbH_3 and for SbH_5 . In this work we have applied this name to SbH_3 and its derivatives only, and have called SbH_5 and its derivatives antimony pentahydride. To illustrate, the compound H_3SbO is called trihydrogen antimony oxide, and H_3SbCl_2 , trihydrogen antimony dichloride. The same nomenclature has been applied to arsine, AsH_3 and its derivatives.

The editors of the E.C.R. are desirous to cooperate with any committee or body of chemists duly appointed for the purpose of studying and improving the present nomenclature and formula writing in the field of inorganic chemistry.

RULES ADOPTED FOR E.C.R. ABSTRACTORS

The following revised rules, having been developed over a period of years, are recommended to abstractors for the E.C.R. They represent the best

practice to date. Over sixteen thousand reactions have been read, corrected and sorted according to these rules.

- (1) Every chemical reaction submitted for inclusion in the E.C.R. should be typed on white, bond paper of the uniform size, 10 x 14 centimeters, (4 x 5½ inches).
- (2) The general arrangement of the data is illustrated in the diagram shown below, but which does not give the exact size of the cards to be used.

ALUMINUM

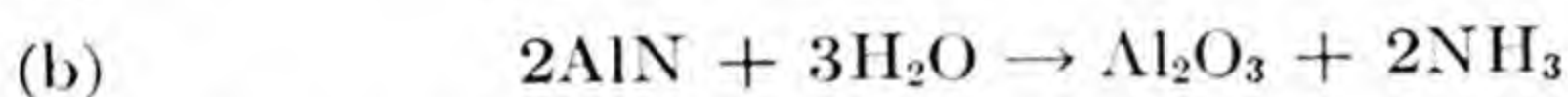
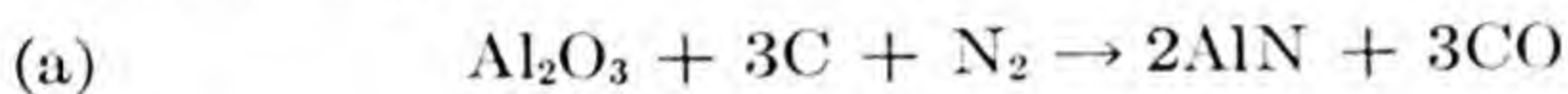


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In the Serpex process for refining aluminous ores the electric resistance furnace charge is heated to 1600–1800°C. The aluminum nitride is then digested in an autoclave under steam pressure.



C. L. Mantell, Chem. Met. Eng., **35**, 746 (1928)

44

Explanation of the entry: The formula of the reactant Al_2O_3 , is placed below the name of the principal element written out at the top of the card. At the top left-hand side of the card are typed the symbols or formulas for the substances that were found to react with the reactant. These are known as the reagents. If only heat, pressure, electricity, bacterial action, etc., were found to effect the change, the proper notation is made in this place. Below these entries is typed a "conditions paragraph" describing in a clear but concise manner the conditions found to govern the reaction, as well as giving the nature (color, odor, crystal form, yield, etc.) of the product formed. This paragraph should also contain, if possible, source of material, solvents employed, temperature, pressure and voltage used. It is to be borne in mind that in order to hold down the size of the E.C.R. to a workable tool, no entry should be longer, including equation, name, and journal reference, than can be typed on one card of the above size specified.

Below this "conditions paragraph" is to be placed one or more balanced equations, expressing the progress of the reaction. If these equations are

not found in the original article abstracted, but are supplied by the abstractor from data found there, the equation or equations are enclosed in parentheses. In this way anyone can tell immediately if the equations are the products of the experimenter or of the abstractor.

Directly below the equation is to be typed the name or names, with their initials, of the authors of the article abstracted, the name of the journal (standard abbreviations), the number of the volume underscored, the page, and the year enclosed in parentheses. The assigned number of the abstractor who made the report is placed at the right of the last reference.

Opposite the reagents on the right is the abstractor's own serial number, showing which card in his series is called in question.

Each abstractor, after having abstracted one or more volumes of his set, will pack up his cards, usually from 10 to 100 and send them by mail to the central office of the E.C.R. The receipt of these cards is immediately acknowledged by post card and then filed for review and criticism. Any cards containing entries or equations that appear spurious or incorrect are returned to the abstractor in question for rechecking.

- (3) The symbol Δ has been employed to represent heat, ϵ to represent the electric current or spark, P , pressure, Bac. to indicate bacterial action, D represents deuterium, and α -Part. for alpha ray bombardment and U. V. Light for ultra violet light.
- (4) When there are two or more equations on the same card, each should be preceded by (a), (b), (c), etc.
- (5) In almost no case does the reaction go to completion. Therefore, we use the arrow to indicate the reaction products and the double arrow when the reaction is definitely reversible. However, since very few typewriters are supplied with arrow keys, we have substituted equality signs and reserved the colon for double bonds.
- (6) The names of compounds whose molecular compositions are complex may be entered in the equations instead of the formulas. The same is true when they serve as reagents.
- (7) When precipitates are formed in the reaction, the formulas of these are underscored both on the cards and in the book. The formulas of crystalline products should not be underscored unless they form, immediately, as a precipitate.
- (8) If probable compounds are formed in the reaction but the author does not so state, formulas of these may be introduced in the equation provided they are enclosed in parentheses.
- (9) If the author has omitted one or more essential products in his reaction and the abstractor is unable or unwilling to venture a guess as to what they are, the equation may be written with the information given, plus a question mark.
- (10) If a change in temperature only produces different types of hydrates

or ammoniates, these may be represented by one equation and the formula of each hydrate or ammoniate followed by the temperature characteristic of each.

- (11) The E.C.R. should cover completely the chemical reactions of all the active elements except those of carbon and oxygen.
- (12) The carbon compounds may be given provisionally as follows: (a) All compounds with carbon and one other element except when that element is hydrogen. (b) All hydrocarbons up to and including six carbon atoms. (c) All compounds containing one or two carbon atoms together with hydrogen and oxygen. (d) Compounds of carbon that are inherently inorganic in nature like the oxalates, carbonyls, cyanides, thiocyanates, etc. (e) Organic compounds of whatever composition that serve as reagents for inorganic processes.
- (13) Erroneous formulas appearing in the older literature like HO for water and C_4H_2 for acetylene may be given in quotation marks, but the correct formulas must be inserted in the equation placed in parentheses.
- (14) The reactions under hydrogen are only those involving hydrogen and one other element, and when that element is carbon the limitation is given in Rule 12 (b).
- (15) Abstractors must make sure that they do not misinterpret and misrepresent the statements made by any author, and it is equally important that the abstractor be able to write the English equivalent of any formula given in the foreign language that he has chosen to abstract.
- (16) For the present at least, the E.C.R. will not present complex graphic formulas, either inorganic or organic. For clearness' sake, unsaturation may be indicated by the double and triple bonds, doing so by the use of dots rather than dashes.
- (17) Patent literature and records of patents should be abstracted and the results obtained put in regular form like all other entries. The patent number and date should be given together with reference to some other published account.
- (18) Many experimenters, after having made a discovery, begin to generalize and make unfounded hypotheses. The latter must be omitted from the E.C.R. so that only reactions with a firm experimental basis are included. Abstractors are therefore cautioned against reporting unfounded guesses.
- (19) Minerals of a definite composition when undergoing chemical change should be included among the reactions under one of the principal elements found in them.
- (20) The formulas for ammoniates should be written with the NH_3 radical at the end of each formula, as illustrated by the following:

$\text{Co}_2\text{NH}_2 \cdot \text{O}_2 \cdot (\text{SO}_4)_2 \cdot 8\text{NH}_3$. It would be incorrect to write the formula $\text{Co}_2\text{NH}_2 \cdot \text{O}_2 \cdot 2\text{SO}_4 \cdot 8\text{NH}_3$, because the 2 in front of the SO_4 radical would in that case also multiply the 8NH_3 by two.

- (21) When a given reaction has been found to hold true with other reagents, this should be stated in the conditions paragraph and the equations entered on the same card, lettered (b), (c), (d), etc.
- (22) Ionic reactions are to be included when they are based upon experimental evidence. No assumptions are taken. The plus and minus signs are then applied to the ions in the customary way.
- (23) Original articles only are to be abstracted. However, much valuable material would be missed in the first volumes of the E.C.R. if we were to omit abstracted articles entirely. Therefore, a certain small proportion of the reactions here submitted came from abstracted articles. However, the name of the author and place of publication are given, together with the location of the reference. The abbreviation Ref. should precede the name and location of the reference.
- (24) The abstractor's assigned number is printed opposite the reference he has submitted. This will enable anyone using the "Encyclopedia" to communicate with the abstractor regarding any given reaction, and also for the abstractor to count or check back on the entries he has made in the E.C.R.
- (25) When an abstractor is willing to contribute time for the completion of this work, but is unable to get his abstracts typed on the cards as explained, we have extended to such a person the privilege of having his reaction cards typed in the General Office in Morgantown. In these cases the handwriting must be plain and easily read. When such typing is done in the General Office a carbon copy of every card is returned to the abstractor for review and filing.

Duplicates

In perusing this work it will be seen that there are several reactions that have been taken from the same source material by different abstractors, and that these are essentially duplications. These ostensible duplicates might have been left out or combined, but since each abstractor has recorded a little different aspect of the reaction, and since the Editor wants to assure to every abstractor full acknowledgment of the work he has done, the reaction as reported was allowed to go in.

Apologies

It would not be fair to the chemical profession to issue a book of this kind purporting to contain *all* the chemical reactions under the elements aluminum, antimony, arsenic, barium, beryllium, bismuth, boron and bromine when we know that only a small fraction of the world's chemical

literature has been covered. The only excuse we give for putting in print the data we have accumulated up to the present is that we propose to continue the abstracting, and to file the data for such a time as Supplement Vol. I can be issued. The supplements will then appear as the data accumulates, and finally the E.C.R. will be brought up to date and kept so.

We also want to apologize for the imperfections that may be found herein. The critic may take a more tolerant attitude when he realizes that the entire work was built by volunteer help, and that most of this help had very little previous training for the abstracting job.

Abstractors have in some cases formulated equations not found in the original articles, and have neglected to put such equations in parentheses as directed in Rule No. 8. Abstractors may also have drawn erroneous conclusions about reactions, so that the conditions paragraph conveys a different meaning from that which the author of the journal article intended. We believe this is a minor error.

It is not surprising to find some errors in a huge mass of data collected from far and near, especially since it was impossible to check the reports of the abstractors, except in a very few cases. Enough checking has been done, however, to satisfy the editors that essentially all the data presented is accurate. After the E.C.R. has been in use for some time, the imperfections in the first volumes will come to light and be corrected in the supplements to follow.

ENCYCLOPEDIA OF CHEMICAL REACTIONS

Note: This entire system is alphabetically arranged first as to the formulas of the reactants and next as to reagents. Volume I covers the reactions submitted to date under the above mentioned elements. The reacting substances under each element have been arbitrarily chosen as the reactants, placed in the center of the page, and one or more reagents, placed at the upper left of each reaction record, as submitted by the abstractor of the original journal article. Opposite the reagent at the right of each entry will be found the serial number of that reaction; for example, the reaction of metallic aluminum with carbon tetrachloride vapor is numbered I-25, which means that 25 is the serial number and that this reaction may be found in Volume I. Below the formula or the symbol of the reactant (in this case Al) will be found a brief statement of the conditions governing the reaction, and below this the reaction expressed in equation form, using the double arrow when the reaction is known to be reversible to an appreciable extent. The formula representing the compound that was precipitated in the reaction is underscored. Below the equation will be found the name or names of the authors of the article, and the place and date of publication. At the right of the last reference the number of the

abstractor who submitted the data for this reaction is given. Many other abstractors, besides those listed in this volume, have submitted reaction data that will be used in succeeding volumes under other elements. To date one hundred and seventeen persons have been assigned journals for abstracting, as well as personal abstractor's numbers.

Before adopting the plan of assigning a number to each abstractor, well over a thousand reactions were obtained and filed without knowing for certain who abstracted them. All these anonymous reactions have been numbered 25.

For convenience in locating any desired reaction two sets of indexes have been placed in the back of the book. The first lists all reagents used as reacting with a given reactant. The symbol \bar{c} found in this index means with. The second index lists also alphabetically all the compounds that have been formed or produced in these reactions, giving reference by number to the reaction where the compound in question may be found.

At the back of the book will also be found a list of names and addresses of the abstractors who contributed reactions for Vol. I together with each one's individual number. There will also be found a list of the journals abstracted together with abbreviations used.

Nearly all reactions recorded in the original literature have been abstracted or referred to by later workers, and such abstract or reference published in another chemical journal. For this reason the name first given represents the author of the reaction, and the name following the Ref., is the person who abstracted or briefly referred to the original work. In many cases our abstractors could obtain only the name of the author of the reaction. The complete publication record might be supplied in supplements to follow.

OUR GOAL

We hope that this work will become a standard of reference on chemical reactions in inorganic chemistry. In order to reach this goal it would be very desirable, if not absolutely essential, to obtain the cooperation of research workers in their respective fields of labor and of authors of books who have specialized in certain phases of inorganic chemistry. These people would be far more competent to abstract reactions that should be included in the E.C.R. than any other person however skilled in abstracting.

When the "Encyclopedia" gets to the place where chemists in general will accept it as a useful tool, it will be to the interest of research workers and authors alike to have the fruits of their labors properly represented in the work. When that time arrives, abstracting by specially assigned abstractors, as at present, will become a negligible quantity.

The corner-stone has now been laid, and we hope the edifice will rise rapidly.

Acc. no. 21098

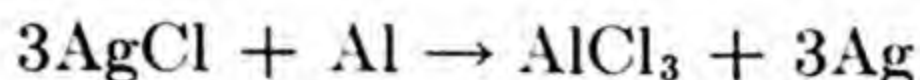
ALUMINUM

Al

AgCl

I-1

Metallic aluminum vigorously reduces molten silver chloride forming silver and aluminum chloride.



A. Cossa, Atti. dell' Istituto Ven. III

Ref.: A. Lieben, Ber., **3**, 368 (1870)

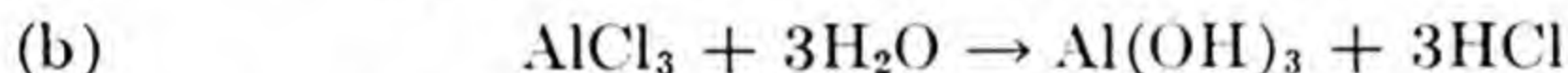
11

Al

AgCl · 2NH₃

I-2

When aluminum is added to an ammoniacal solution of silver chloride, silver is liberated.



A. Cossa, Atti. dell' Istituto Ven. III

Ref.: A. Lieben, Ber., **3**, 203 (1870)

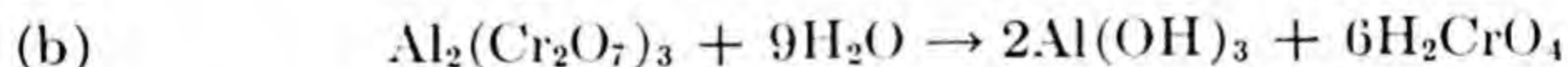
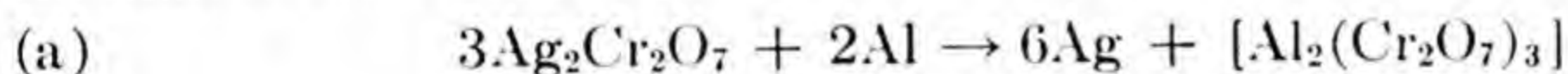
11

Al

Ag₂Cr₂O₇

I-3

Metallic aluminum, when added to an ammoniacal solution of silver dichromate, causes reduction of the silver.



A. Cossa,

Ref.: A. Lieben, Ber., **3**, 204 (1870)

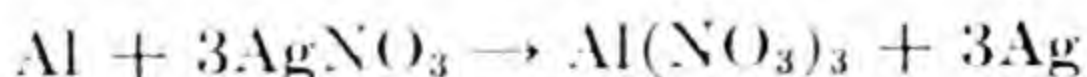
11

Al

AgNO₃

I-4

If aluminum is dipped into a solution of silver nitrate (dilute or concentrated), fine crystals of metallic silver deposit.



Jaroslav Heyrovský, J. Chem. Soc., **117**: **1**, 29 (1919)

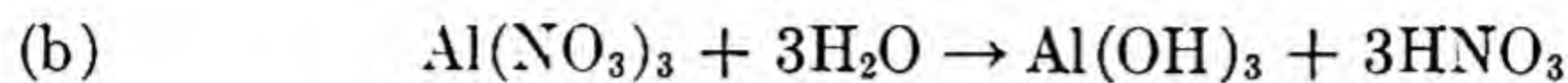
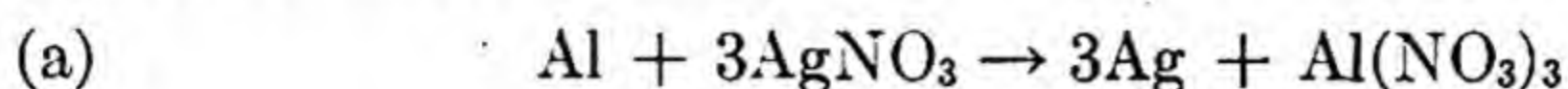
48

Al

AgNO₃

I-5

Metallic aluminum replaces silver in silver nitrate when added to a solution of silver nitrate.



A. Cossa,

Ref.: A. Lieben, Ber., **3**, 203 (1870)

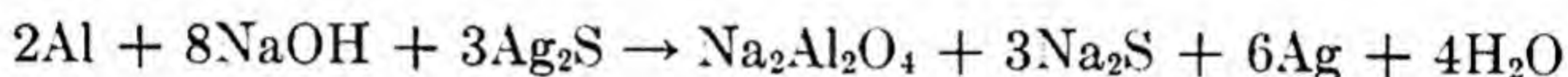
11

Al

Ag₂S + NaOH

I-6

Silver sulfide and aluminum ingots agitated in a solution of caustic soda yield metallic silver.



C. Spearman, Can. Chem. Met. Eng., **9**, 57 (1925)

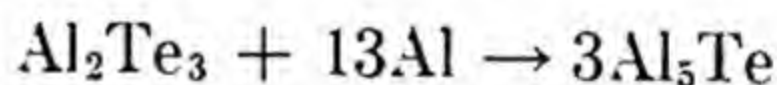
12

Al

Al₂Te₃

I-7

An aluminum telluride is formed when Al₂Te₃ undergoes a transformation in presence of aluminum below 551°.



Chikashigl and Nose, Mem. Coll. Sci., Kyoto, **2**, 227 (1917)

Ref.: J. Chem. Soc. (London), **114**, 114 (1918)

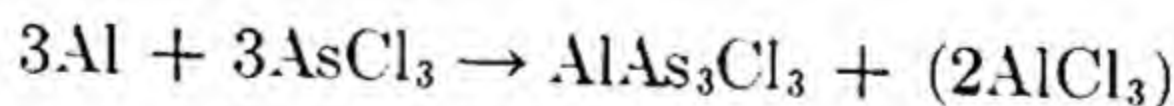
1

Al

AsCl₃

I-8

Aluminum triarsenic trichloride is formed when aluminum and arsenic trichloride are heated in a tube at 140° for a long time in the presence of a little aluminum chloride.



Ruff and Staib, Z. anorg. Chem., **117**, 193 (1921)

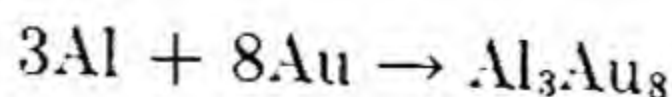
25

Al

Au

I-9

An aluminum-gold alloy forms from a melt with 28 per cent by volume of aluminum at about 580°.



C. T. Heycock and F. H. Neville, Trans. Roy. Soc. (London), **214A**, 267 (1914)

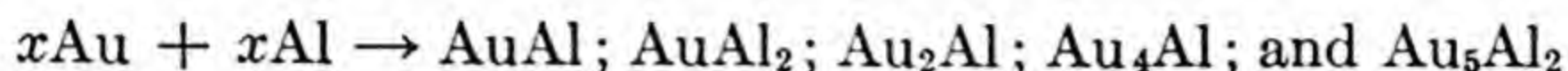
105

Al

Au

I-10

By melting together mixtures of aluminum and gold of various compositions the following alloys have been recognized:



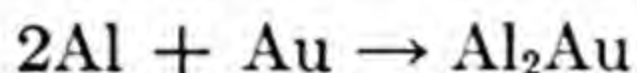
C. T. Heycock and F. H. Neville, *Trans. Roy. Soc. (London)*, **194A**, 201-32 (1900) 105

Al

Au

I-11

Analysis of freezing-point data for systems of aluminum-gold-tin, as reported by Heycock and Neville [*J. Chem. Soc.*, **65**, 65 (1894)], shows that one of the stable phases is a definite compound.



E. S. Shepherd, *J. Phys. Chem.*, **8**, 92 (1904)

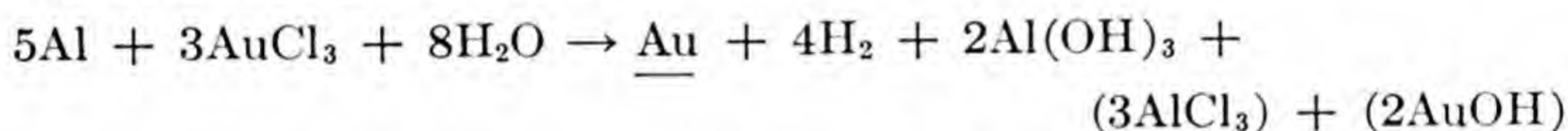
7

Al

AuCl₃

I-12

When aluminum is dipped into a dilute solution of gold chloride, metallic gold is immediately deposited with strong evolution of hydrogen. The solution turns violet.



Jaroslav Heyrovský, *J. Chem. Soc.*, **117**: **1**, 29 (1920)

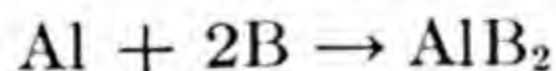
48

Al

B

I-13

By fusing together boron with aluminum in excess at 1000° aluminum boride is obtained.



H. Funk, *Z. anorg. Chem.*, **142**, 269 (1925)

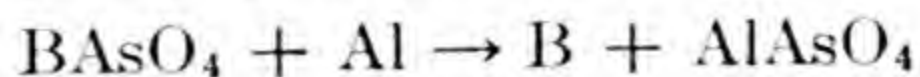
28

Al

BAsO₄

I-14

Boron arsenate is reduced by aluminum.



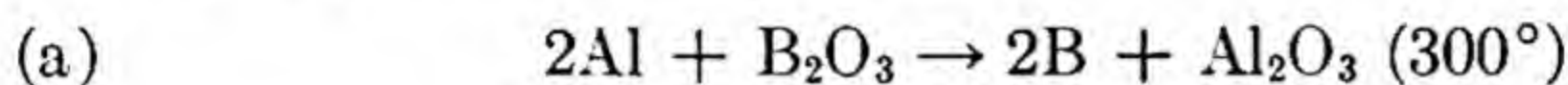
E. Berger, *Compt. rend.*, **171**, 29 (1920)

25

Al

B₂O₃**I-15**

The reduction of boric anhydride by aluminum is not recommended for the preparation of metallic boron, since increasing amounts of aluminum borides are produced as the excess of B₂O₃ is diminished.



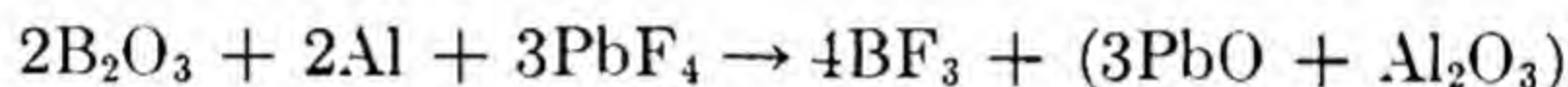
F. Weston and H. Russell, *Trans. Far. Soc.*, **3**, 174 (1907)

85

Al

B₂O₃**I-16****PbF₄**

Boron trioxide is ignited with a mixture of aluminum and lead tetrafluoride.



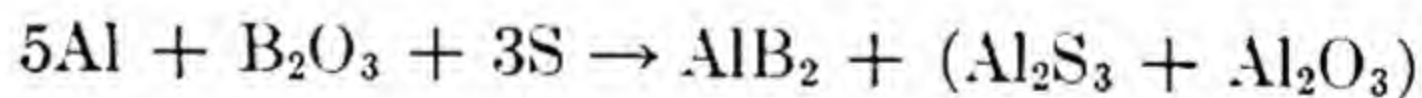
E. Berger, *Compt. rend.*, **171**, 29 (1920)

25

Al

B₂O₃ + S**I-17**

An aluminum boride is formed when a mixture containing an excess of aluminum turnings, magnesium powder, sulfur and boron trioxide is heated at a low temperature.



H. Funk, *Z. anorg. Chem.*, **142**, 269 (1925)

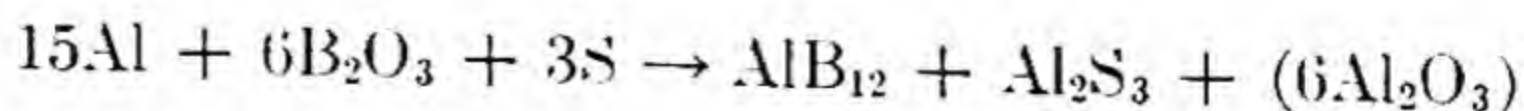
Ref.: *J. Chem. Soc. (London)* **128**, 705 (1925)

25

Al

B₂O₃ + S**I-18**

An aluminum boride is obtained when an intimate mixture of boron trioxide, sulfur and aluminum is ignited with a piece of magnesium ribbon.



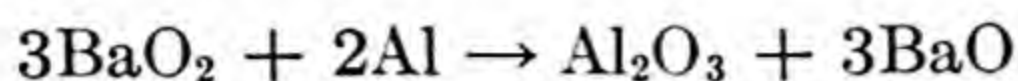
Blitz: *Ber.*, **41**, 2634 (1903)

1

Al

BaO₂ **I-19**

Barium peroxide is reduced to the oxide by the use of powdered aluminum at a high temperature.



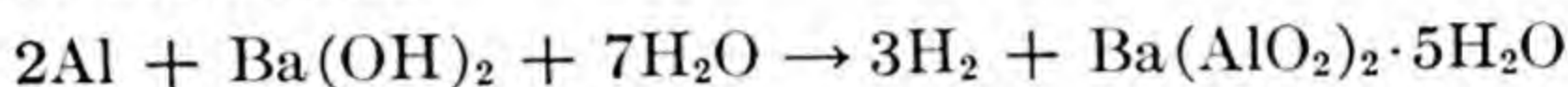
Hirsch, J. Ind. Eng. Chem., **3**, 886 (1911)

22

Al

Ba(OH)₂ **I-20**

Barium aluminate is formed when a hot solution of barium hydroxide reacts with aluminum.



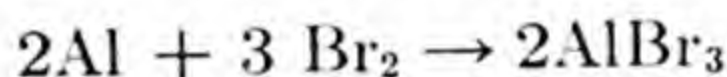
Allen and Roger, Am. Chem. J., **24**, 304 (1900)

25

Al

Br₂ **I-21**

A piece of aluminum was lowered into liquid bromine; when violent action began it was withdrawn. This was repeated until violent action ceased and then the aluminum was left in the bromine.



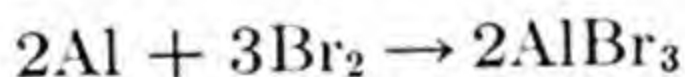
J. W. Mallette, Trans. Roy. Soc. (London), **171**, 1003-35 (1881)

105

Al

Br₂ **I-22**

Aluminum powder distilled with bromine yields aluminum tribromide.



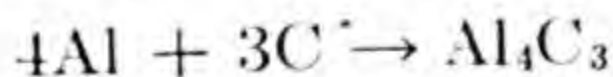
Ref.: Homer, J. Chem. Soc. (London), **91**, 1103 (1907)

109

Al

C **I-23**

Charcoal heated with aluminum reacts to form aluminum carbide. The reaction is slow at 650° and rapid at 1400°.



Franck, Chem. Z., **22**, 236 (1898)

Ref.: J. N. Pring, J. Chem. Soc., (London), **93**, 2103 (1908)

Ref.: Baly and Marsden, J. Chem. Soc. (London), **93**, 2108 (1908)

Ref.: C. Matignon, Bull. Soc. Chim. (4), **3**, 356 (1908)

Ref.: J. F. Durand, Bull. Soc. Chim. [IV], **35**, 171 (1924)

57

103

31

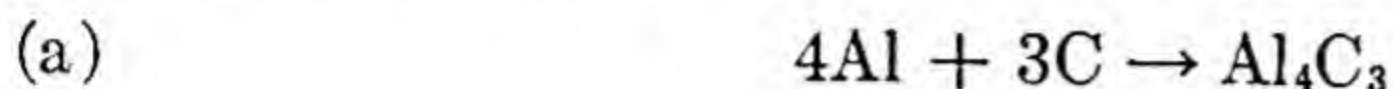
31

Al

C

I-24

Aluminum powder (in excess) and charcoal or graphite can be made to react, with a fuse of Mg and BaO₂, or upon heating in a muffle furnace at temperatures varying from 400° to 1100°. Aluminum oxide and nitrides are formed as contaminants due to air.



F. Weston and H. Ellis, *Trans. Far. Soc.*, **4**, 61 (1908)

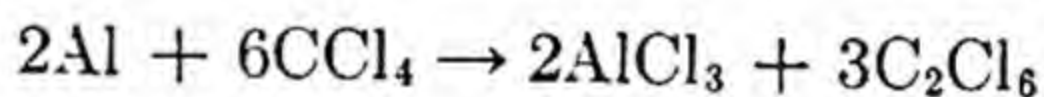
85

Al

CCl₄

I-25

Metallic aluminum reacts rapidly with dry vapor of carbon tetrachloride at 100°–120° to form aluminum chloride and hexachloroethane.



E. Baulieu, Jr., *Ind. Eng. Chem.*, **17**, 911 (1925)

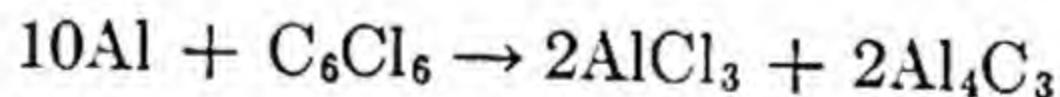
23

Al

C₆Cl₆

I-26

Powdered aluminum mixed with hexachlorobenzene in a sealed tube and heated to 225° produces aluminum carbide. The reaction is exothermic and small quantities should be used to prevent explosions.



C. Matignon, *Bull. Soc. Chim. (4)*, **3**, 359 (1908)

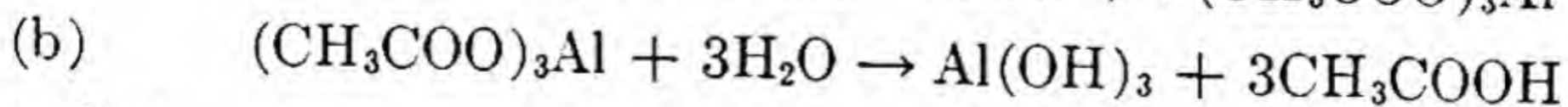
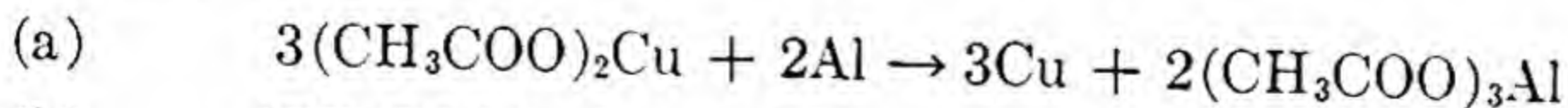
31

Al

(CH₃COO)₂Cu

I-27

Metallic aluminum slowly displaces copper from a solution of copper acetate.



A. Cossa

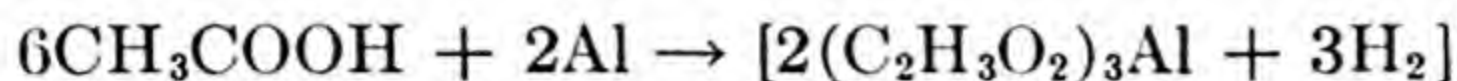
Ref.: A. Lieben, *Ber.*, **3**, 204 (1870)

11

Al

CH₃COOH**I-28**

Aluminum metal dissolves slowly in strong acetic acid in presence of hydrogen peroxide at 15°.



Hodges, Chem. News, **123**, 141 (1921)

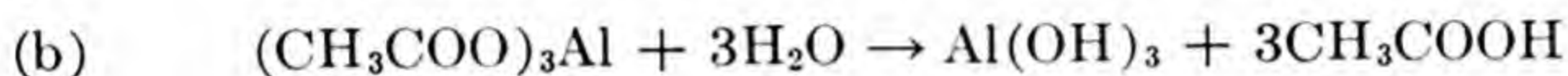
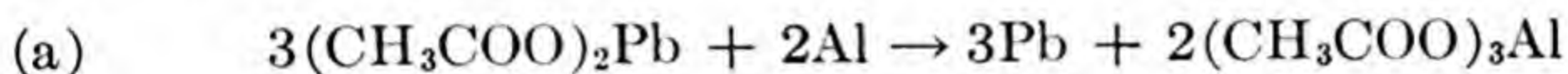
Ref.: J. Chem. Soc. (London), **120**, 589 (1921)

25

Al

(CH₃COO)₂Pb**I-29**

Metallic aluminum slowly reacts with a solution of lead acetate to form metallic lead.



A. Cossa,

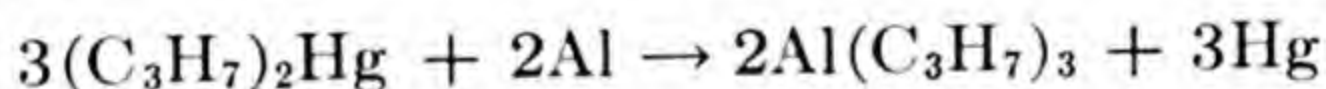
Ref.: A. Lieben, Ber., **3**, 204 (1870)

11

Al

(C₃H₇)₂Hg**I-30**

Aluminum when heated to 130° with mercury dipropyl forms tripropyl aluminum and mercury.



A. Cahours,

Ref.: A. Henninger, Ber. **6**, 568 (1873)

11

Al

C₂H₅I**I-31**

At ordinary pressure and in an atmosphere of inert gas, recently distilled, dry ethyl iodide reacts readily with powdered aluminum at 72°. The resulting solution contains a mixture of the two products.



Grignard and Jenkins, Bull. Soc. Chim. (IV), **35**, 845 (1924)

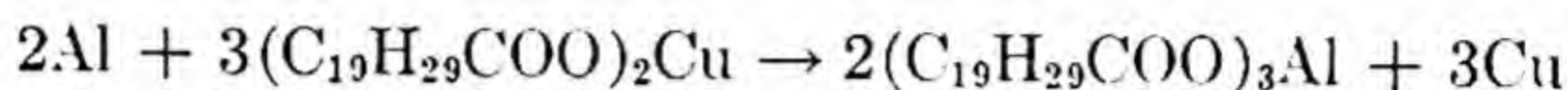
31

Al

 $(C_{20}H_{29}O_2)_2Cu$

I-32

Copper in copper abietate is replaced by aluminum when a solution of copper abietate is allowed to stand in contact with the metal. Similar substitutions are effected when aluminum is left in contact with the solutions of the copper salts of the following acids: cinnamic, acetoacetic, palmitic, margaric, phthalic, camphoric, lauric, caproic and isovalerianic.



C. B. Gates, *J. Phys. Chem.*, **15**, 97 (1911)

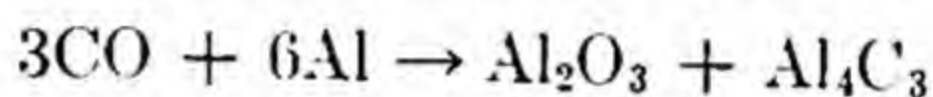
7

Al

CO

I-33

If aluminum is melted and boiled in the presence of carbon monoxide it forms aluminum trioxide and aluminum carbide.



J. N. Pring, *J. Chem. Soc.*, (London), **87**, 1532 (1905)

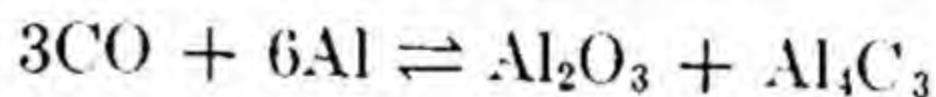
103

Al

CO

I-34

When metallic aluminum is treated with carbon monoxide at high temperatures, aluminum oxide and aluminum carbide are formed.



J. N. Pring, *J. Chem. Soc.* (London), **87**, 1532 (1905)

102

Ref.: R. E. Slade, *Ibid.*, **93**, 332 (1908)

57

Ref.: R. E. Slade, *loc. cit.*

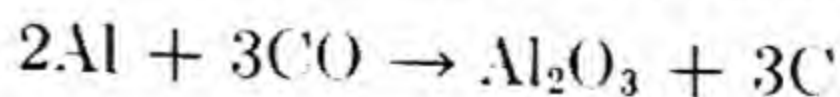
102

Al

CO

I-35

Aluminum is easily and completely oxidized to aluminum oxide by the action of carbon monoxide. The latter reduces to carbon.



Roland E. Slade and Geoffrey I. Higson, *J. Chem. Soc.*, **115**: **1**, 212 (1919)

48

Al

CO

I-36

Aluminum reacts with carbon monoxide at 1200-1300°.



Bruck, *Bull. Soc. Chim.* (3), **11**, 439 (1894)

25

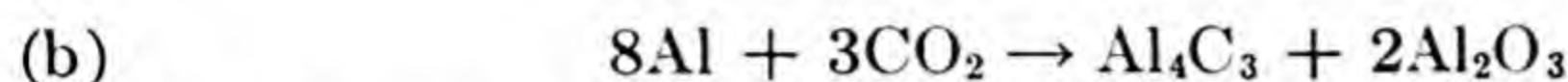
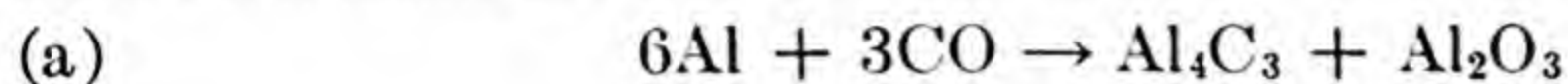
Al

CO

I-37

CO₂

Aluminum in presence of a trace of AlCl₃ reacts with CO and CO₂ to form aluminum carbide and alumina.



Guntz and Masson, *Compt. Rend.*, **134**, 187 (1897)

Ref.: J. N. Pring, *J. Chem. Soc. (London)*, **93**, 2103 (1908)

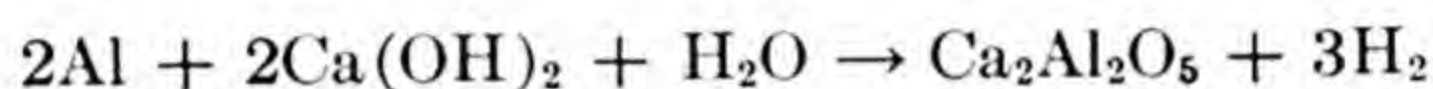
57

Al

Ca(OH)₂

I-38

An aluminate is formed when aluminum reacts with a solution of lime water.



Allen and Rogers, *Am. Chem. J.*, **24**, 304 (1900)

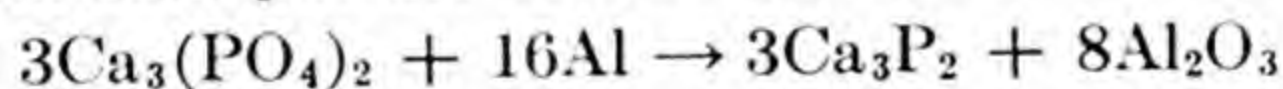
25

Al

Ca₃(PO₄)₂

I-39

Calcium phosphide can be prepared by heating a mixture of the phosphate with aluminum powder to dull redness in a crucible.



C. Matignon and R. Trannoy, *Compt. rend.*, **148**, 167 (1909)

Ref.: G. Ter Gazarian, *J. Chim. phys.*, **7**, 337 (1909)

69

Ref.: Matignon and Trannoy, *Bull. Soc. Chim. (4)*, **5**, 267 (1909)

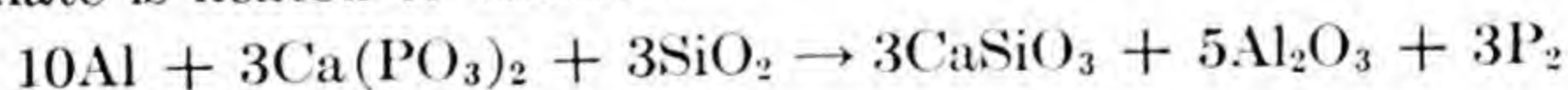
31

Al

Ca(PO₃)₂ + SiO₂

I-40

Phosphorus is formed along with a mixture of aluminum oxide and calcium silicate when a mixture of aluminum, sand and calcium metaphosphate is heated to redness.



Rossel and Frank, *Ber.*, **27**, 52 (1894)

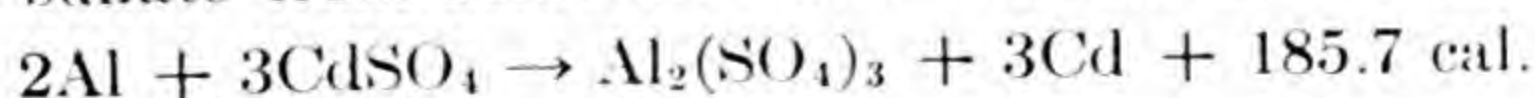
25

Al

CdSO₄

I-41

Cadmium sulfate and aluminum metal react to release cadmium and aluminum sulfate from solution. The reaction is exothermic.



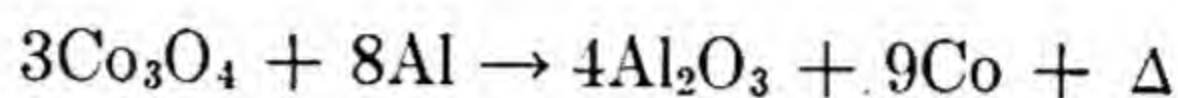
J. Salouze, *Bull. Soc. Chim. (4)*, **51**, 1350 (1932)

31

Al

Co₃O₄**I-42**

When cobalt tetroxide is intimately mixed with powdered aluminum and ignited, a violent reaction takes place releasing a large amount of heat.



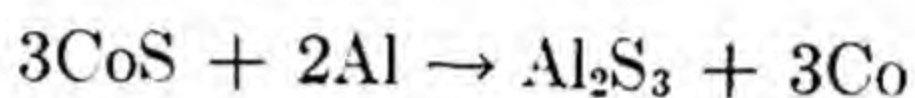
H. T. Kalmus, *J. Ind. Eng. Chem.*, **6**, 114 (1914)

22

Al

CoS**I-43**

Cobalt sulfide is added to fused aluminum and the mixture is heated in an atmosphere of inert gas.



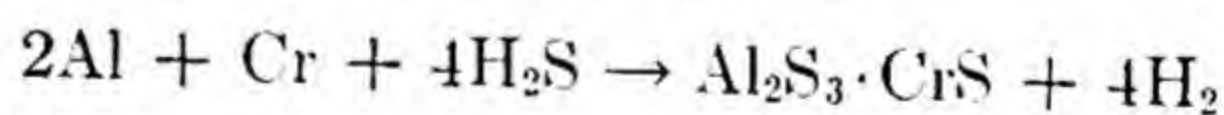
Parravani and Agoatini, *Gazz. Chim. Ital.*, **49**, I, 103 (1919)

25

Al

**Cr
H₂S****I-44**

On heating, in a stream of H₂S, a mixture of aluminum and chromium in the proportions of 2:1 with a slight excess of aluminum, one obtains a black crystalline mass attacked by water, and leaving a reddish crystalline residue. After washing with HCl, etc., the residue was found to have the composition shown below.



M. Houdard, *Compt. Rend.*, **144**, 1114, 21, 5 (1907)

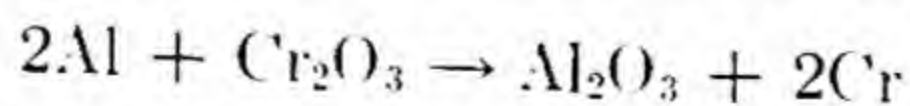
Ref.: R. Marquis, *Bull. Soc. Chim. (4)*, **1**, 843 (1907)

31

Al

Cr₂O₃**I-45**

Metallic chromium is prepared when a mixture containing theoretical amounts of aluminum powder and chromium trioxide is ignited.



Goldschmidt, *Ann.*, **301**, 27 (1898)

1

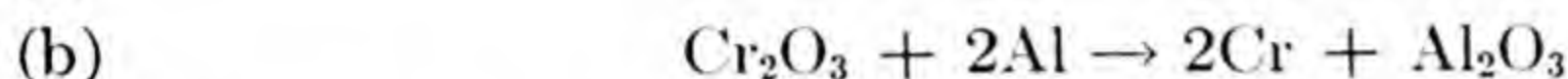
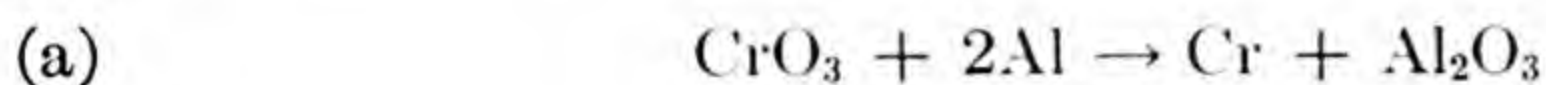
Al

CrO₃
Cr₂O₃

I-46

Metallic aluminum, 98.5% pure, is obtained by fusing a mixture of chromic oxide and chromium trioxide with powdered aluminum (600:120:270) in a magnesia-lined crucible. The vigorous exothermic reaction ensuing lasts about a minute.

The impurities in the chromium are usually silicon, aluminum and iron.



Emile Vigoroux, Bull. Soc. Chim. [4] **1**, 10 (1907)

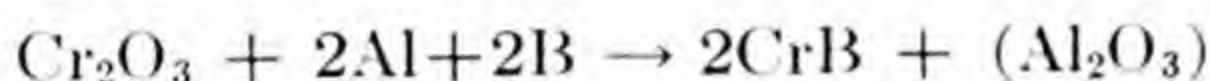
25

Al

Cr₂O₃
B

I-47

Amorphous boron is heated to 2000°–3000° by means of a mixture of chromic oxide and aluminum.



Wedekind and Fetzner, Ber., **40**, 297 (1907)

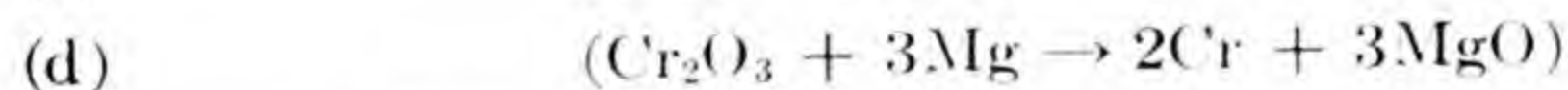
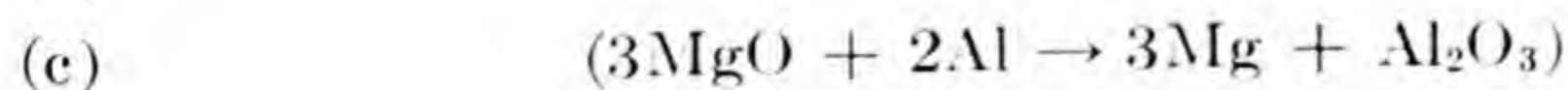
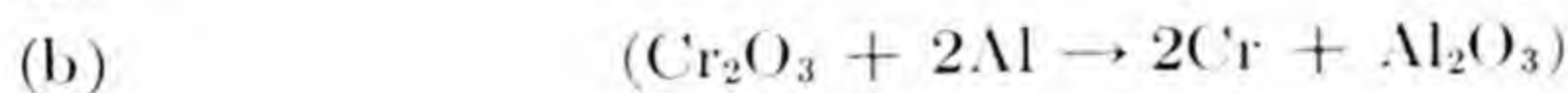
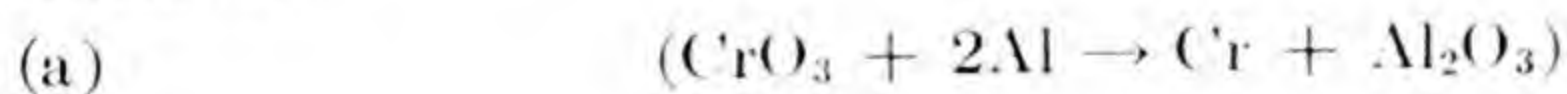
25

Al

CrO₃
MgO

I-48

Chromium may be prepared in a very pure state by heating a mixture of chromic anhydride or the sesquioxide with aluminum in a magnesia-lined crucible. Some metallic magnesium may also serve to reduce the oxides of chromium as shown in equation (d). The reaction is complete in one or two minutes, depending on the proportions of reactants.



E. Vigouroux, Bull. Soc. Chim., **1**, 10 (1907)

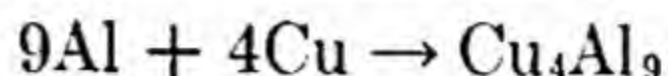
31

Al

Cu

I-49

A brittle, silvery white, lustrous compound is obtained when equal parts by weight of copper and aluminum are melted together.



Brunck, Ber., **34**, 2733 (1901)

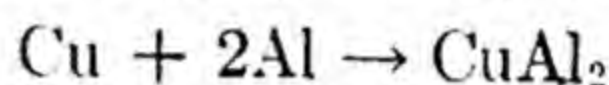
25

Al

Cu

I-50

The equilibrium diagram for the Cu-Al system above 400° shows that the only definite compound formed is that given below, but six series of solid solutions are observed. There is no evidence for the previously claimed compounds: Cu_3Al , Cu_4Al , Cu_3Al_2 , and Cu_2Al_5 .



Be. E. Curry, J. Phys. Chem., **11**, 425 (1907)

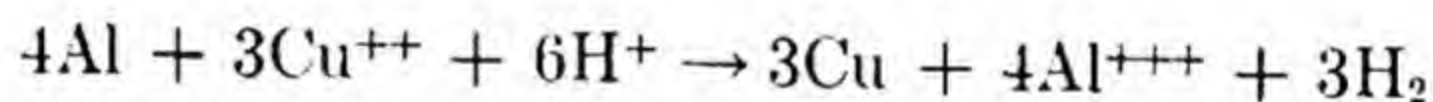
7

Al

CuCl₂

I-51

If aluminum is dipped into a solution of cupric chloride, metallic copper deposits readily with slow evolution of hydrogen; the solution is decolorized.



Jaroslav Heyrovský, J. Chem. Soc., **117**: 1, 29 (1919)

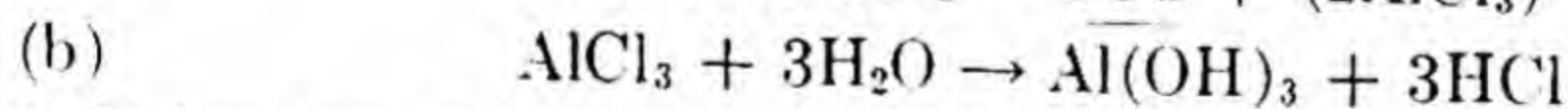
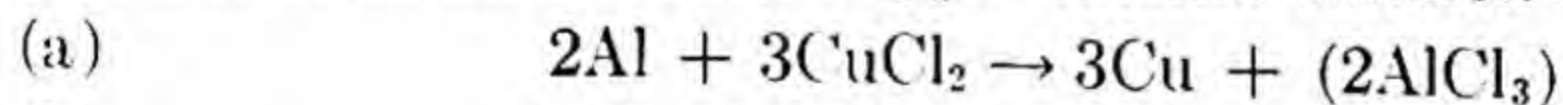
48

Al

CuCl₂

I-52

Metallic aluminum reduces copper chloride solution to metallic copper.



A. Lieben, Ber. **3**, 204 (1870)

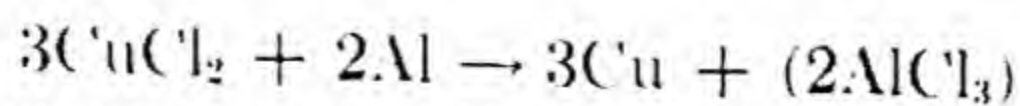
11

Al

CuCl₂

I-53

By treating a cupric chloride solution with aluminum the copper will be deposited at once, but the deposition is slower from a cupric acetate solution. The deposition from the sulfate and nitrate solutions is only appreciable after two days. The Cu will then be in the form of octahedral crystals.



A. Cossa, Atti dell' Instituto Veneto [3] **5**, 1

Ref: A. Lieben, Ber. **3**, 204 (1870)

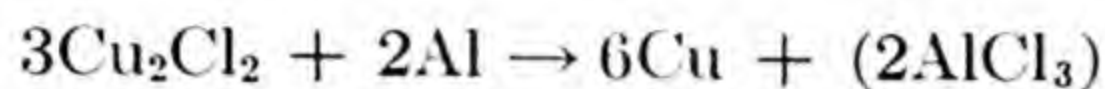
25

Al

Cu₂Cl₂**I-54**

Pure copper may be obtained by the reduction of a cuprous chloride solution with aluminum metal.

Aluminum turnings are added to a cuprous chloride solution. Frequent stirring or shaking hastens the reaction; 500 grams of turnings react in less than 24 hours. When the reaction is complete the copper metal falls to the bottom of the flask and the supernatant liquid is clear.



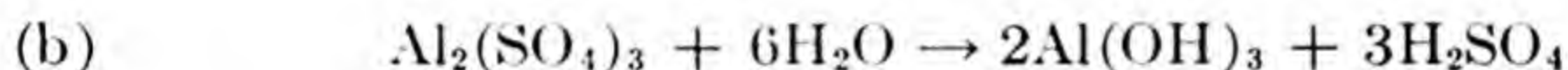
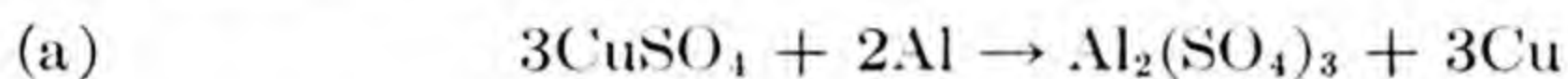
E. Vigouroux, *Bull. Soc. Chim.*, **1**, 9 (1907)

31

Al

CuSO₄**I-55**

Metallic aluminum slowly reacts with a solution of copper sulfate to form metallic copper.



A. Cossa,

Ref.: A. Lieben, *Ber.*, **3**, 204 (1870)

11

Ref.: J. H. Heyrovský, *J. Chem. Soc.*, **117**: **1**, 29 (1919)

48

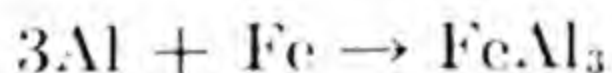
Ref.: E. Vigouroux, *Bull. Soc. Chim.*, **1**, 10 (1907)

31

Al

Fe**I-56**

Iron-gray, dense, lance-shaped crystals are obtained when one part of iron and three parts of aluminum are melted together and crystallized from 2% hydrochloric acid.



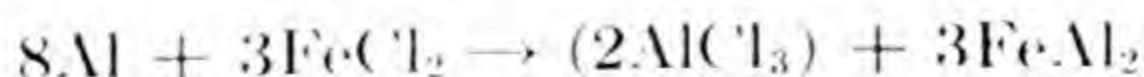
Brunck, *Ber.*, **34**, 2733 (1901)

1

Al

FeCl₂ + NaCl**I-57**

Six-sided prisms were obtained when aluminum, ferrous chloride and sodium chloride were melted together.



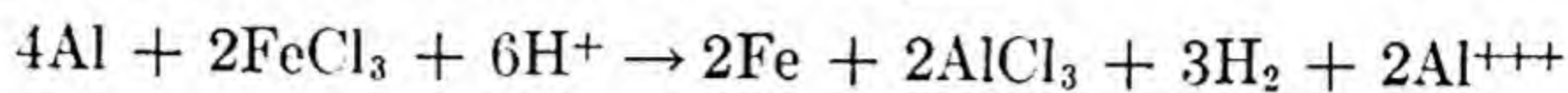
Michel, *Ann.*, **115**, 104 (1860)

1

Al

FeCl₃**I-58**

If aluminum is dipped into a solution of ferric chloride, a dark powder deposits, with slow evolution of hydrogen.



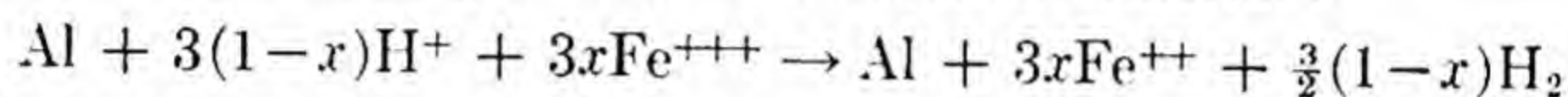
Jaroslav Heyrovský, J. Chem. Soc., **117**: 1, 29 (1920)

48

Al

FeCl₃**I-59**

Metallic aluminum dissolves in an aqueous solution of ferric chloride and part of the hydrogen evolved reduces the chloride:



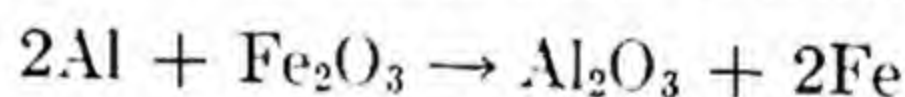
W. Heller, J. Chim. Phys., **29**, 488 (1932)

69

Al

Fe₂O₃**I-60**

If finely powdered aluminum is mixed with Fe₂O₃ and enough heat applied to start the reaction, the ferric oxide is reduced to molten iron.



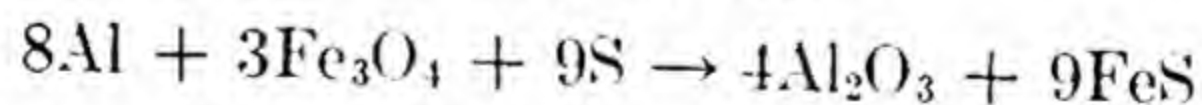
H. T. Kalmus, J. Ind. Eng. Chem., **6**, 114 (1914)

22

Al

Fe₃O₄**I-61****S**

If a finely powdered mixture of aluminum, magnetite and sulfur is ignited, the following reaction takes place.



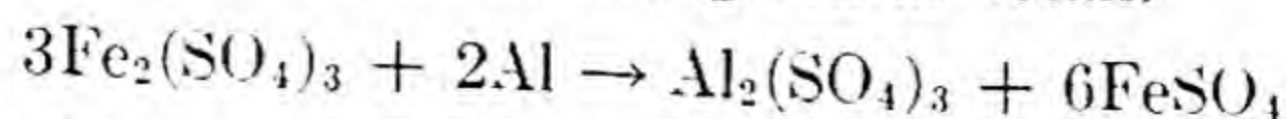
A. B. Ray, J. Ind. Eng. Chem., **13**, 642 (1921)

22

Al

Fe₂(SO₄)₃**I-62**

Aluminum in aluminum powder may be quantitatively determined by reducing ferric sulfate in aqueous medium and carbon dioxide atmosphere, then titrating the ferrous sulfate formed by a potassium permanganate solution. The method is given in detail.



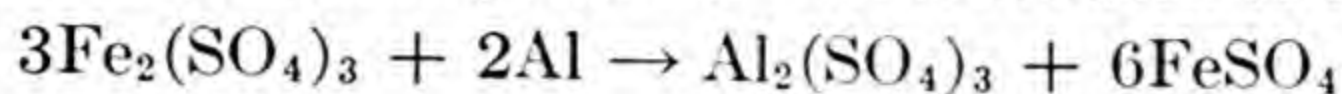
E. Kohn-Abrest, Compt. rend., **147**, 1294 (1908)

38

Al

Fe₂(SO₄)₃**I-63**

One gram of aluminum powder is mixed with ferric sulfate (about 25 g) and dissolved in 75 cc of water, and heated to 100°. The aluminum is oxidized to aluminum sulfate, and the iron is reduced to ferrous sulfate.



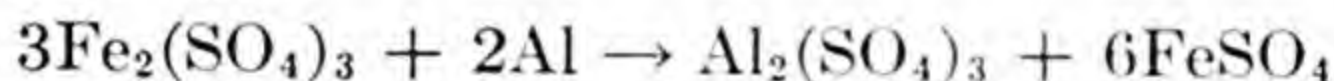
Kohn-Abrest, *Ann. Chim. Anal.*, **14**, 96 (1909)

76

Al

Fe₂(SO₄)₃**I-64**

0.5 g of metallic aluminum powder is put in a small-neck flask and together with 20 g of ferric sulfate diluted in 50 cc of water. A current of carbon dioxide is passed through the solution and the solution is heated on a water bath.



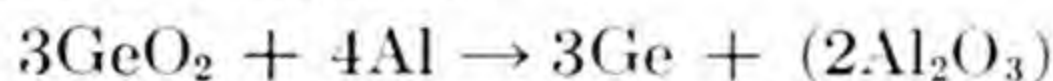
E. Kohn-Abrest, *Ann. Chim. Anal.*, **9**, 382 (1904)

100

Al

GeO₂**I-65**

Metallic germanium is formed when a mixture of germanium dioxide and granular aluminum is ignited.



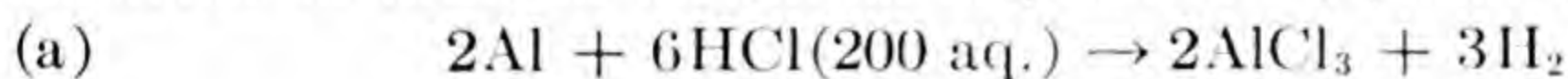
Dennis, Tressler and Hance, *J. Am. Chem. Soc.*, **45**, 2033-34 (1923)

1

Al

HCl**I-66**

Aluminum dissolves in hydrochloric acid with evolution of hydrogen. The heat of the reaction (a) is 41.033 calories; it can be regarded as the difference of heats of ionization of processes (b) and (c).



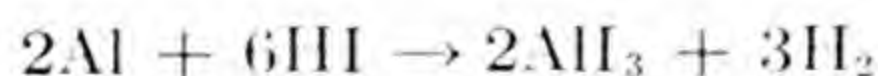
Jaroslav Heyrovský, *J. Chem. Soc.*, **117**: **1**, 35 (1920)

48

Al

HI**I-67**

Metallic aluminum dissolves readily in liquid hydriodic acid, yielding aluminum iodide.



Norris and Cottrell: *Am. Chem. J.*, **18**, 100 (1896)

1

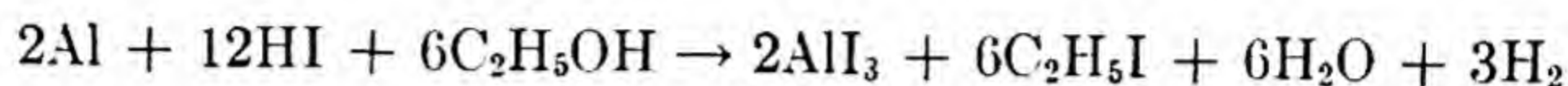
Al

HI

I-68

 $\text{C}_2\text{H}_5\text{OH}$

Hydrogen iodide is passed into ethyl alcohol containing powdered aluminum.



Jones and Green, J. Chem. Soc., 928 (1927)

25

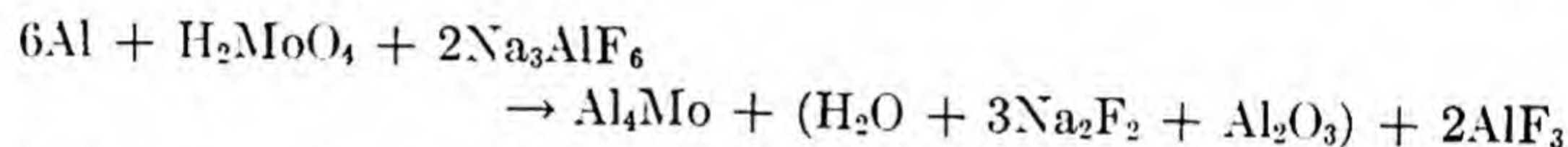
Al

 H_2MoO_4

I-69

 Na_3AlF_6

A black crystalline powder is obtained when the residue after evaporating molybdic acid with hydrofluoric acid is ignited with a mixture of aluminum and cryolite.



Michel: Ann., 115, 102 (1860)

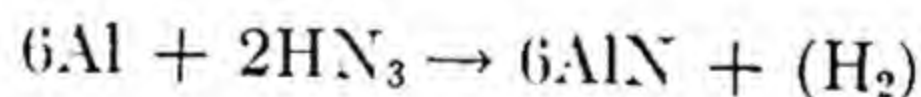
1

Al

 HN_3

I-70

Aluminum nitride forms when powdered aluminum is heated to a low red heat in a current of dry triazoic acid.



Sofianopoulos, Bull. soc. chim., (4), 5, 614

Ref.: J. L. How, J. Am. Chem. Soc., 31, 1292 (1909)

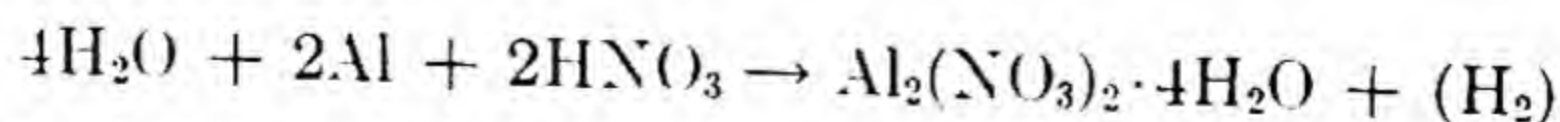
1

Al

 HNO_3

I-71

A basic aluminum nitrate is formed when dilute nitric acid is reacted with aluminum.



A. Ditte, Compt. rend., 110, 782

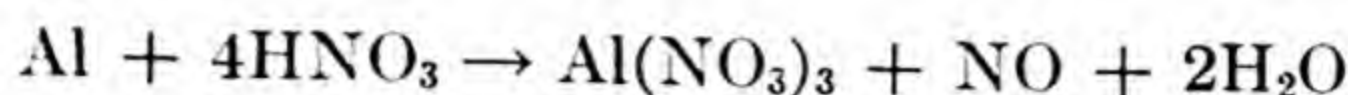
Ref., J. Am. Chem. Soc., 19, 716 (1897)

1

Al

HNO₃**I-72**

Aluminum reacts with 5–20% nitric acid at 25–30° slowly with formation of aluminum nitrate.



Van Deventer, Chem. Weekblad, **4**, 69 (1907)

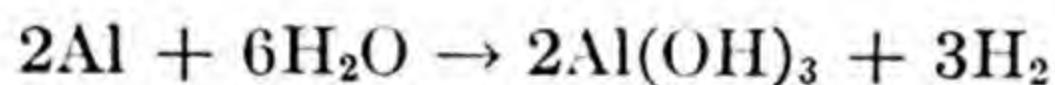
Ref.: J. Chem. Soc., **92**, 265 (1907)

1

Al

H₂O**I-73**

The combined action of the hydrogen cation and the chloride, bromide and iodide anions activates aluminum so that it decomposes water with evolution of hydrogen. Dilute or concentrated hydrochloric acid or potassium, barium and sodium hydroxide cause strong evolution of hydrogen.



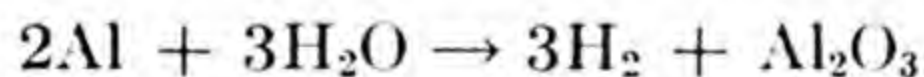
Jaroslav Heyrovský, J. Chem. Soc., **117:1**, 28 (1920)

48

Al

H₂O**I-74**

Aluminum in the presence of AlI₃, AlCl₃ or AlBr₃, decomposes water to form aluminum oxide and hydrogen.



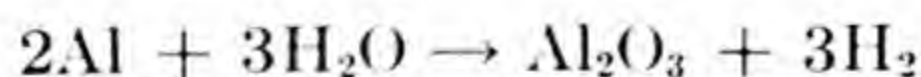
R. Gerstl, Ber. **8**(1), 831 (1875)

26

Al

H₂O**I-75**

Pure hydrogen may be produced by reacting water with finely divided aluminum to which has been added small amounts of mercuric chloride and potassium cyanide. To obtain the maximum yield of hydrogen, one liter of water is reacted with 1 kg. of the metal and additions, the heat of reaction being held below 80°.



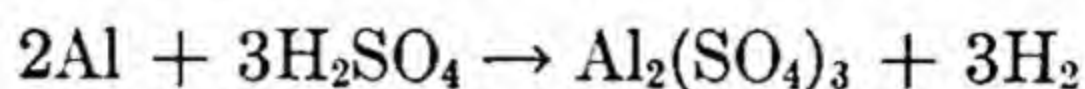
Mauricheau-Beaupré, Compt. rend., **147**, 310 (1908)

38

Al

H₂SO₄**I-76**

Sulfuric acid reacts with aluminum at ordinary conditions producing hydrogen and aluminum sulfate. (Quantitative for hydrogen.)



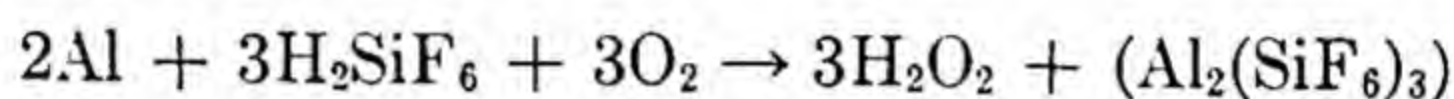
J. H. Capps, *J. Ind. Eng. Chem.*, **13**, 810 (1921)

22

Al

H₂SiF₆**I-77**

Hydrogen peroxide is formed if aluminum is shaken with a 1% solution of fluosilicic acid in the air.



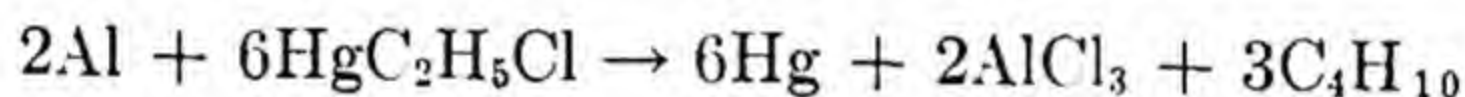
Fischer and Priess, *Ber.*, **46**, 698 (1913)

25

Al

HgC₂H₅Cl**I-78**

Mercuric ethyl chloride in benzene reacts easily with aluminum on warming, producing a gas which is probably butane.



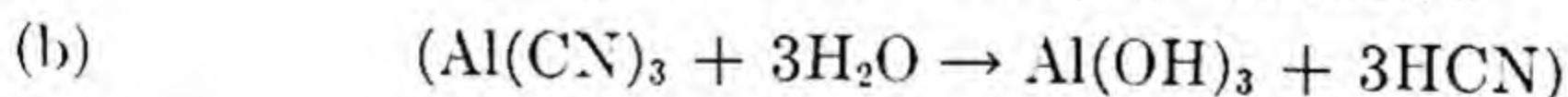
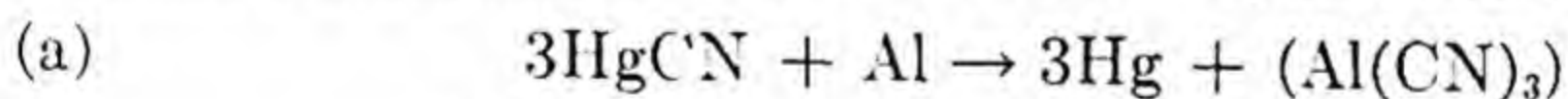
J. L. Sammis, *J. Phys. Chem.*, **10**, 593 (1906)

7

Al

HgCN**I-79**

Metallic aluminum reacts with mercurous cyanide to form free mercury.



A. Cossa,

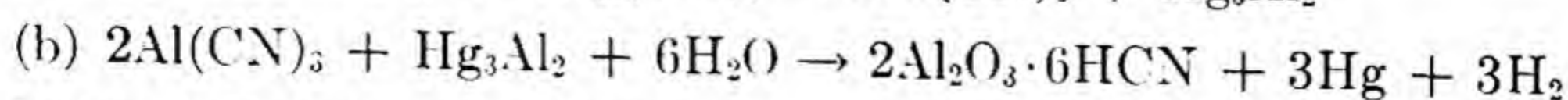
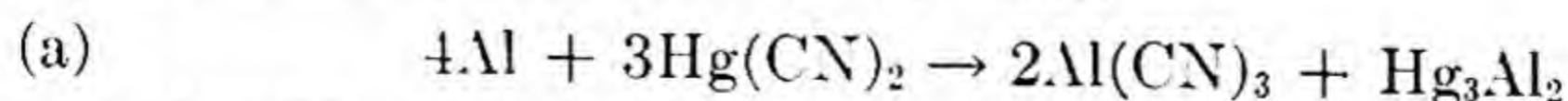
Ref.: A. Lieben, *Ber.*, **3**, 204 (1870)

11

Al

Hg(CN)₂**I-80**

Mercury is formed along with a double compound when aluminum is treated with aqueous mercuric cyanide.



R. Varet, *Compt. rend.*, **112**, 224

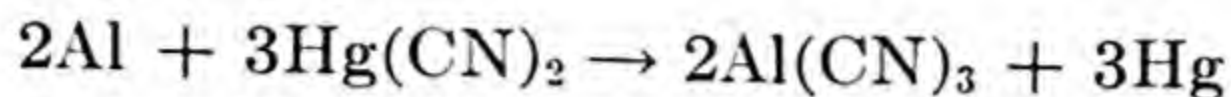
Ref., *Ber.*, **25**, 189 (1892)

25

Al

Hg(CN)₂**I-81**

Aluminum and mercuric cyanide react in liquid ammonia to form aluminum cyanide and mercury.



F. W. Bergstrom, J. Am. Chem. Soc., **46**, 1559 (1924)

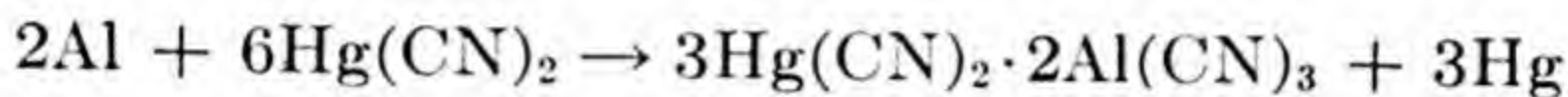
13

1

Al

Hg(CN)₂**I-82**

A double mercuric aluminum cyanide is formed when aluminum dissolves in mercuric cyanide.



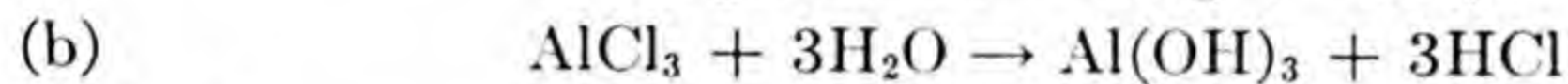
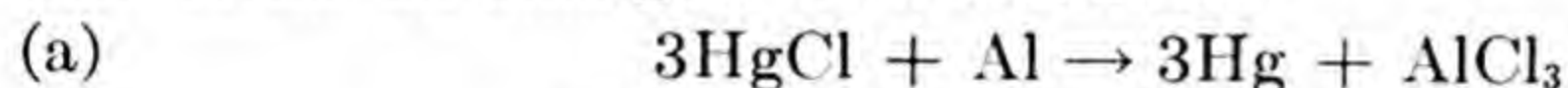
F. W. Bergstrom, J. Am. Chem. Soc., **46**, 1564 (1926)

1

Al

HgCl**I-83**

Metallic aluminum reacts with calomel to form free mercury, which then forms an amalgam with aluminum.



A. Cossa,

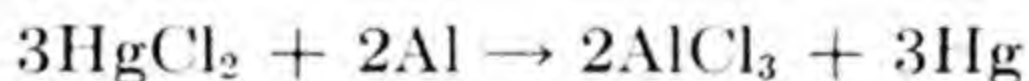
Ref., A. Lieben, Ber., **3**, 204 (1870)

11

Al

HgCl₂**I-84**

When a thin aluminum plate is slightly heated with dry mercuric chloride a vigorous reaction takes place, whereby aluminum chloride and free mercury are formed.



A. Cossa,

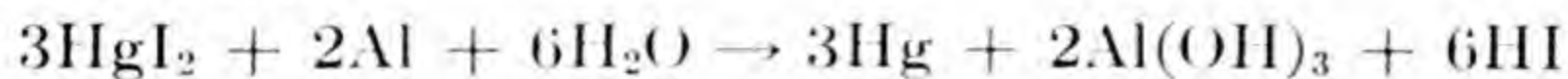
Ref., Ad. Lieben, Ber., **3**, 368 (1870)

11

Al

HgI₂**I-85**

Metallic aluminum liberates mercury from a solution of mercuric iodide in potassium iodide.



A. Cossa,

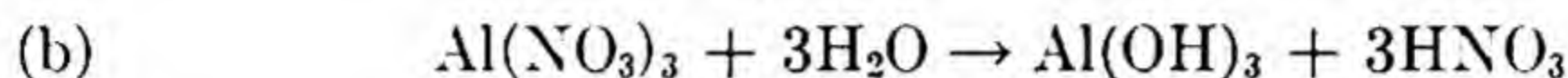
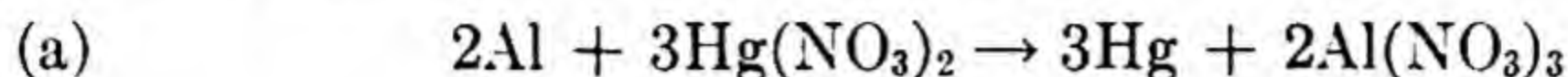
Ref., Ad. Lieben, Ber., **3**, 368 (1870)

11

Al

Hg(NO₃)₂**I-86**

Metallic aluminum reacts with mercuric nitrate to form free mercury.



A. Cossa,

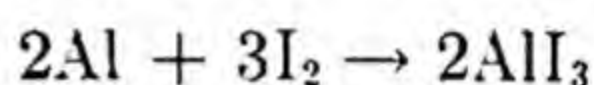
Ref., A. Lieben, Ber., **3**, 204 (1870)

11

Al

I₂**I-87**

Aluminum iodide is formed when the necessary amount of iodine is heated with aluminum in a stream of dry carbon dioxide.



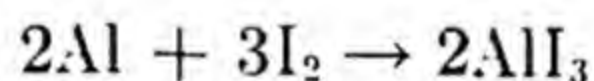
M. Gustavson, Ann., **172**, 173 (1874)

25

Al

I₂**I-88**

Aluminum iodide is formed when iodine is dissolved in carbon disulfide and sheet aluminum added.



P. De Boissieu, Bull. Soc. Chim., **49**, 17

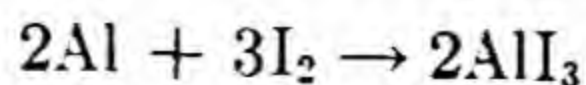
Ref., M. L., J. Am. Chem. Soc., **10**, 114 (1888)

1

Al

I₂**I-89**

Aluminum wire or sheet is placed in a retort arranged so that gas may be passed through it. Not more than $\frac{1}{200}$ to $\frac{1}{100}$ of the calculated amount of iodine is added while a stream of carbon dioxide is being passed through the system. The reaction is vigorous and light is evolved, when the retort is heated. After the reaction slows, additional small portions of the iodine are added. So much heat is produced that the aluminum triiodide is liquid. The stream of carbon dioxide is stopped during the additions of iodine. After all of the iodine has been added the mixture is heated until it is liquid.



M. G. Gustavson, Ann. Chem. u. Pharm., **172**, 173 (1874)

20

ALUMINUM

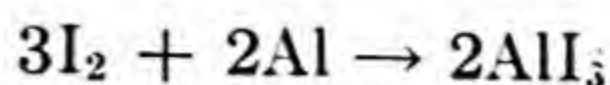
41

Al

I₂

I-90

Aluminum in alcohol is added to a solution of iodine, yielding aluminum triiodide.



Jones and Green, *J. Chem. Soc. (London)* (1927), p. 928

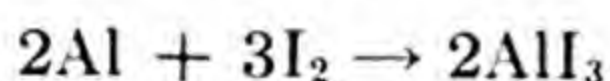
25

Al

I₂

I-91

Aluminum wire is heated with I₂ in an atmosphere of carbon dioxide. AlI₃ is successively distilled, from excess of Al, from one retort into the next one. The final product is heated in a sealed tube with Al wire until the iodine disappears. Pure AlI₃, melts at 191°C.



V. Izbekov and A. Nijnik, *J. Gen. Chem. (USSR)*, **7**, 1268 (1937)

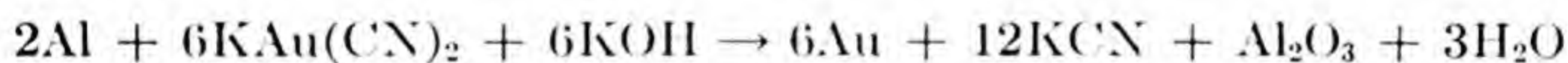
60

Al

KAu(CN)₂ + KOH

I-92

Metallic gold and aluminum trioxide separate while potassium cyanide is formed when an alkaline solution of potassium aurocyanide is treated with aluminum.



Moldenhauer, D. R. P. 74532 (1893)

Ref.: *Ber.*, **27**, 678 (1894)

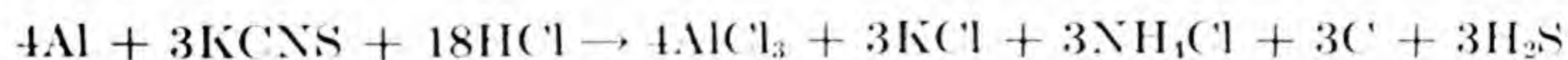
25

Al

KCNS + HCl

I-93

Hydrogen sulfide is evolved quantitatively when a solution of potassium thiocyanate is treated with aluminum and hydrochloric acid.



P. Dobiner, *Z. anal. Chem.*, **46**, 737 (1907)

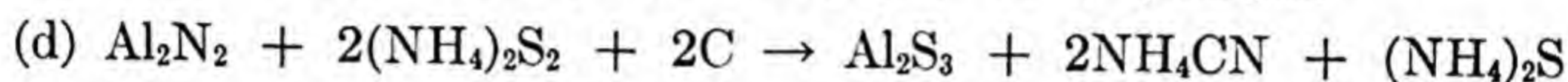
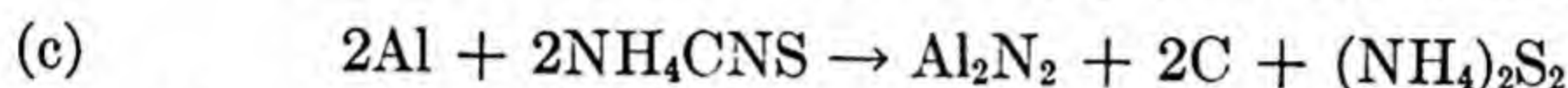
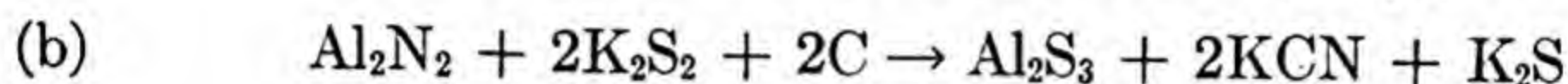
1

Al

KCNS
NH₄CNS

I-94

A mixture of dry aluminum powder and potassium thiocyanate powder is ignited. The temperature of the reaction is 900°. Aluminum nitride is formed. At elevated temperatures aluminum sulfide is obtained. The same type reaction occurs with ammonium thiocyanate.



A. C. Vournason, *Z. anorg. Chem.*, **77**, 191 (1912)

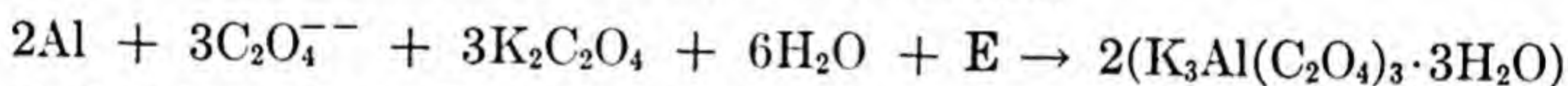
28

Al

K₂C₂O₄

I-95

When solutions of potassium oxalate are electrolyzed with an aluminum anode complex anions of this metal are formed.



F. H. Jeffery, *Trans. Far. Soc.*, **19**, 53 (1923)

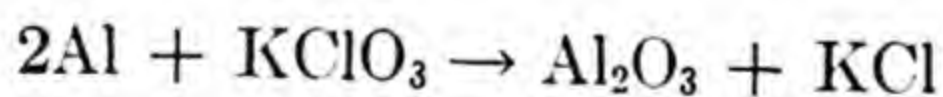
85

Al

KClO₃

I-96

The terms: explosion, effect of explosion, thermite, are discussed in respect to the reaction:



H. Schimank, *Z. Elektrochem.*, **24**, 213 (1918)

86

Al

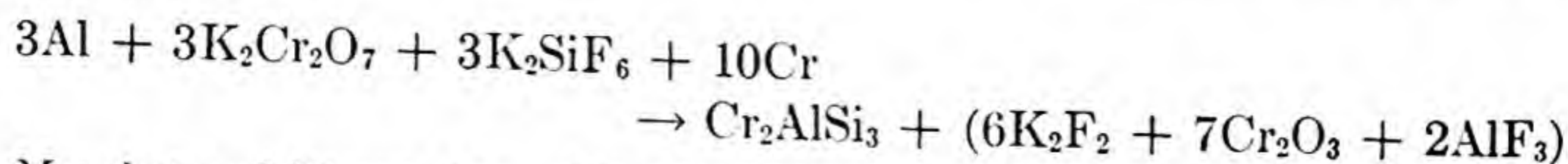
K₂Cr₂O₇

I-97

K₂SiF₆

Cr

A double silicide of aluminum is formed when 2.6 grams of chromium, a corresponding amount of potassium dichromate, 40 grams potassium fluosilicate and 44 grams aluminum are heated together strongly for one half hour.



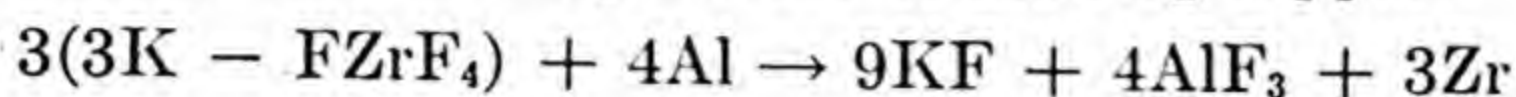
Manhot and Kieser, *Ann.*, **337**, 354 (1904)

1

Al

3KF · ZrF₄**I-98**

Metallic aluminum reduces potassium fluoride-zirconium fluoride to metallic zirconium at the temperature of melting copper.



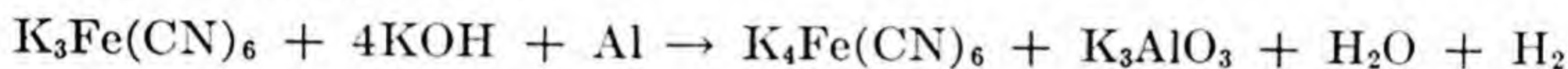
Benno Franz, *Ber.*, **3**, 59 (1870)

11

Al

K₃Fe(CN)₆ + KOH**I-99**

Potassium ferricyanide is reduced by aluminum filings in the presence of potassium hydroxide.



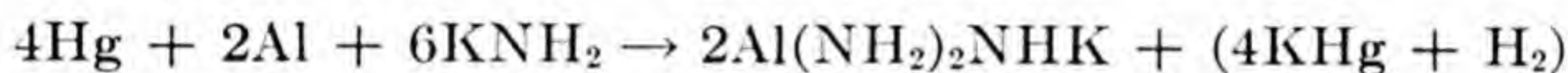
L. E. Preiss, *Am. Chem. J.*, **28**, 240 (1902)

1

Al

KNH₂**I-100**

Potassium ammono aluminate is formed when amalgamated aluminum is dissolved in a solution of potassium amide.



F. W. Bergstrom,

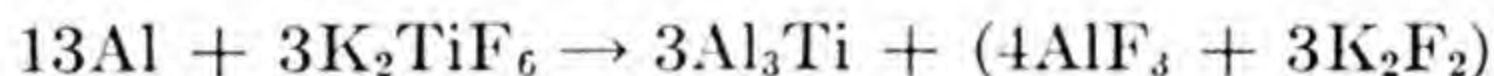
Ref., *J. Am. Chem. Soc.*, **46**, 1548 (1924)

1

Al

K₂TiF₆**I-101**

Aluminum titanide is formed when a mixture of potassium fluotitanate and aluminum is heated to 700°–1400°.



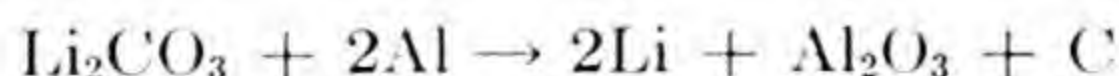
Manchot and Leber, *Z. anorg. Chem.*, **150**, 26 (1925)

25

Al

Li₂CO₃**I-102**

Heat lithium carbonate with aluminum in the proportion 2:1. The free lithium metal is formed together with carbon and alumina. The metal alloys with the excess aluminum and a small amount of aluminum carbide is formed.



L. Franck, *Bull. Soc. Chim. Paris* (3) **11**, 439; and *Chem. Zeit.*, **22**, 236 (1898) (1894)

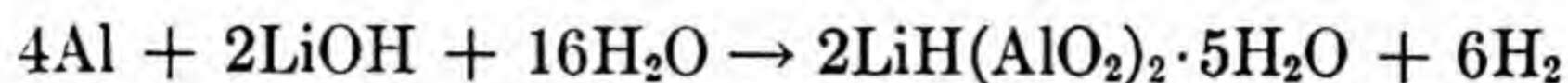
2

Al

LiOH

I-103

An aluminate is formed when aluminum reacts with a solution of lithium hydroxide.



Allen and Rogers, Am. Chem. J., **24**, 304 (1900)

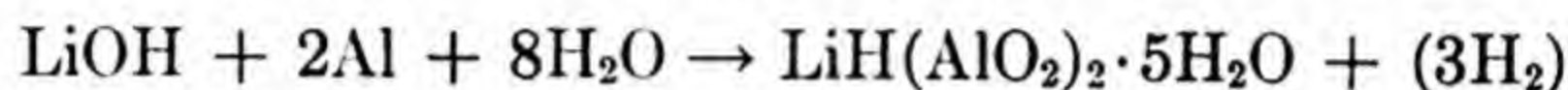
25

Al

LiOH + H₂O

I-104

Caustic lithia reacts with aluminum quite vigorously. A white granular substance separates which is a difficultly soluble aluminate.



E. T. Allen and H. F. Rogers, Am. Chem. J., **24**, 304-318 (1900)

2

Ref.: Dobbins and Sanders, J. Am. Chem. Soc., **54**, 178 (1932)

1

Ref.: J. Hegrousky, J. Chem. Soc., **118**, 1013 (1920)

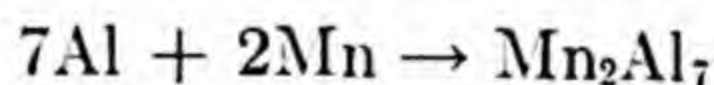
1

Al

Mn

I-105

Thin white crystals are obtained when one part of manganese and six parts of aluminum are melted together under a layer of common salt and then treated with 2% hydrochloric acid.



Brunch, Ber., **34**, 2733, (1901)

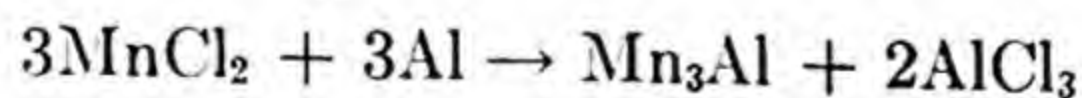
25

Al

MnCl₂

I-106

Manganese chloride and metallic aluminum when melted together form an alloy which will scratch glass.



Terreil,

Ref., A. Henninger, Ber., **7**, 363 (1874)

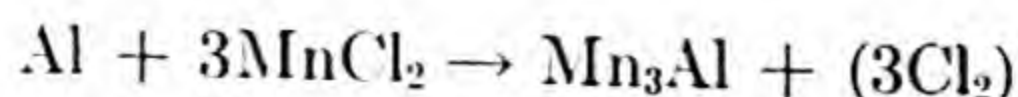
11

Al

MnCl₂

I-107

A crystalline alloy is obtained when aluminum is melted with manganoous chloride.



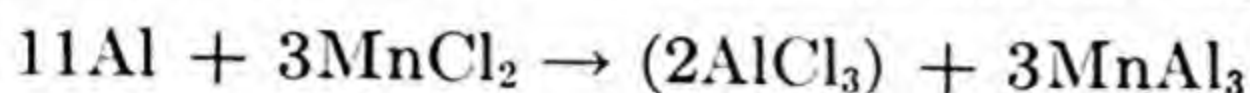
Terreil, Ber. **7**, 363, 1874

25

Al

MnCl₂**I-108**

A dark gray crystalline powder is obtained when anhydrous manganese chloride, sodium chloride and aluminum are melted together.



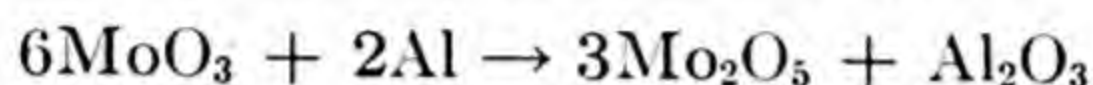
H. Michel, *Ann.* **115**, 104 (1860)

25

Al

MoO₃**I-109**

An oxide is probably formed when an intimate mixture of molybdenum trioxide and powdered aluminum are heated in air.



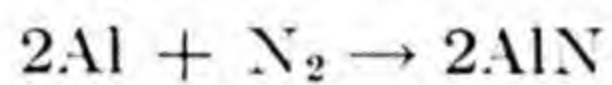
C. H. Ehrenfeld, *J. Am. Chem. Soc.*, **17**, 393 (1895)

1

Al

N₂**I-110****(Na₂CO₃)**

When heated strongly aluminum (in the presence of sodium carbonate) reacts with nitrogen to form a slaggy mass of aluminum nitride and aluminum. This is an extremely hard substance rivaling topaz.



J. W. Mallet,

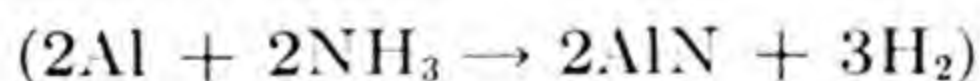
Ref., R. Gerstl, *Ber.*, **9**, 1, 949 (1876)

26

Al

NH₃**I-111**

Ammonia gas will react with powdered aluminum at between 820° and 850° to produce aluminum nitride.



D. Wolk, *Bull. Soc. Chim. [IV]*, **7**, 772 (1910)

31

Al

NH₃**I-112**

Powdered aluminum is heated in a porcelain tube about to its fusion temperature, and a stream of NH₃ is passed through it. The following reactions result:



Ath. J. Sofianopoulos, *Bull. Soc. Chim.*, [4], **5**, 616 (1909)

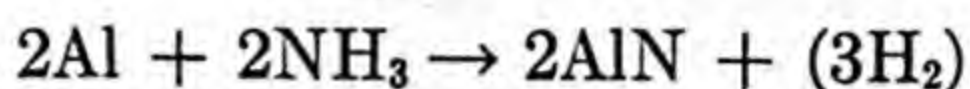
31

Al

NH₃

I-113

Aluminum nitride is readily prepared by heating aluminum powder to a low red heat, insufficient to fuse the aluminum, in a current of dry ammonia.



Sofianopoulos, Bull. Soc. Chim. [4], 5, 614

Ref.: J. L. Howe, J. Am. Chem. Soc., 31, 1292 (1909)

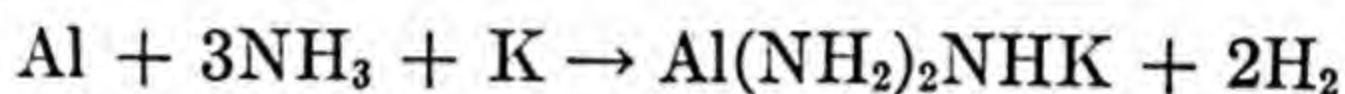
1

Al

NH₃ + K

I-114

Amalgamated aluminum reacts with a solution of potassium in liquid ammonia to produce potassium ammono-aluminate.



F. W. Bergstrom, J. Am. Chem. Soc., 46, 1548 (1926)

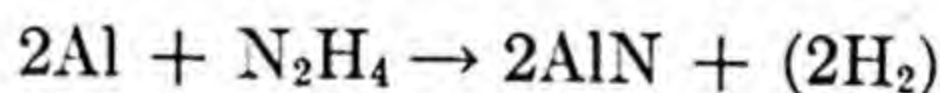
1

Al

N₂H₄

I-115

Aluminum nitride is formed when powdered aluminum is heated to a low red heat in a current of hydrazine vapors.



Sofianopoulos, Bull. soc. chim. [4], 5, 614 (1908)

Ref., J. L. Howe, J. Am. Chem. Soc., 31, 1292 (1909) (Abstract)

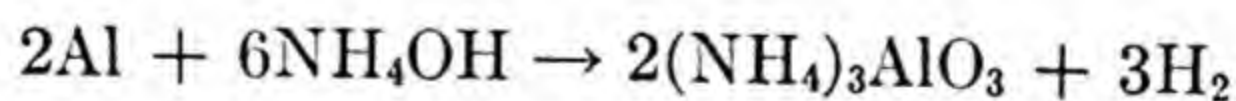
1

Al

NH₄OH

I-116

Ammonium orthoaluminate is formed when aluminum dissolves in ammonium hydroxide.



Gottig, Ber., 29, 1671 (1896)

1

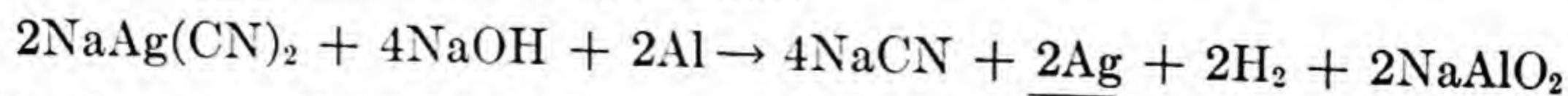
Al

NaAg(CN)₂

NaOH

I-117

Silver is precipitated from its solution in sodium silver cyanide by aluminum dust and sodium hydroxide.



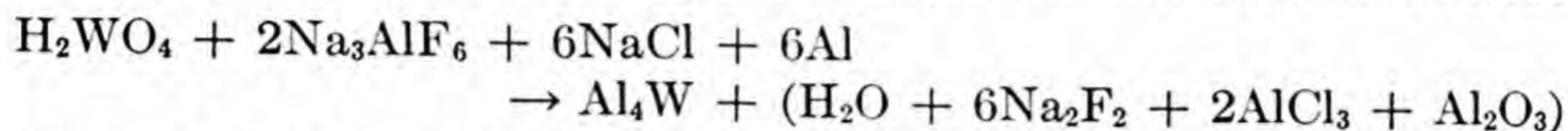
C. Spearman, Can. Chem. Met. Eng., 9, 57 (1925)

15

Al

Na₃AlF₆**H₂WO₄****NaCl****I-118**

An iron gray crystalline powder is obtained when tungstic acid is melted with a mixture of cryolite, aluminum and sodium chloride.



Michel, Ann., **115**, 102 (1860)

1

Al

Na₂CO₃**I-119**

Aluminum reduces sodium carbonate at a high temperature producing alumina and sodium.



J. W. Mallet, J. Chem. Soc. (London), **30**, 349 (1876)

13

Al

Na₂CO₃**I-120**

Free carbon and sodium aluminate are formed when sodium carbonate is strongly heated with aluminum.



C. and A. Tissier, Compt. rend., **43**, 1187

Ref., Ann., **186**, 155 (1877)

25

Al

Na₂CO₃**I-121****N**

Aluminum nitride is produced by heating aluminum in a graphite crucible for several hours at a moderate temperature with dry sodium carbonate.



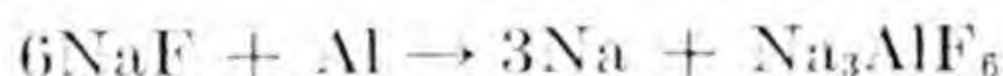
J. W. Richards, J. Ind. Eng. Chem., **5**, 333 (1913)

22

Al

NaF**I-122**

Heat together metallic aluminum and sodium fluoride.



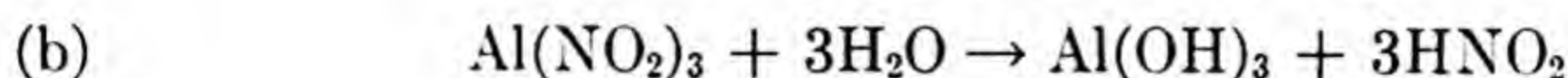
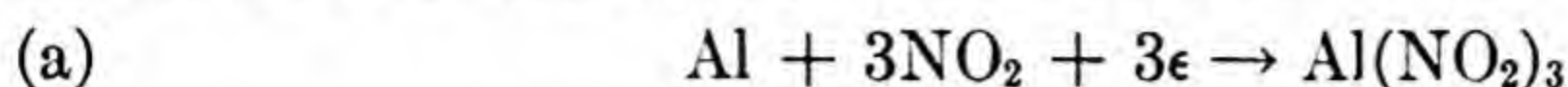
Heinrich Specketer, Z. Angew. Chem., **26**, 111 (1913)

34

Al

NaNO₂**I-123**

When sodium nitrite solutions are electrolyzed with an aluminum anode, the products are hydrated aluminum oxide, NO and HNO₂.



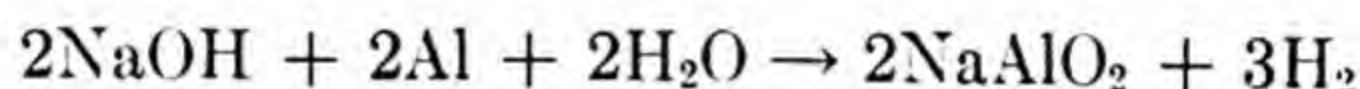
F. H. Jeffery, *Trans. Far. Soc.*, **19**, 53 (1923)

85

Al

NaOH**I-124**

Sodium metaluminate is formed when aluminum dissolves in sodium hydroxide.



Allen and Rogers, *Am. Chem. J.*, **24**, 304 (1900)

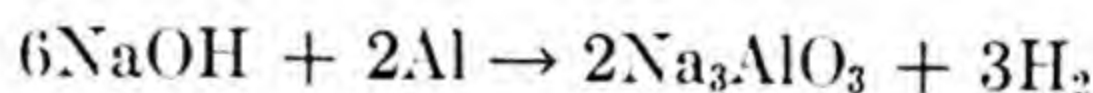
Ref., *J. Chem. Soc. (London)*, **78**, 727 (1900)

1

Al

NaOH**I-125**

Aluminum reacts with a strong sodium hydroxide solution liberating hydrogen.



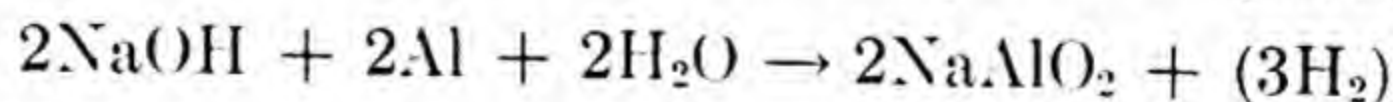
J. W. Mallette, *Trans. Roy. Soc. (London)*, **171**, 1003 (1881)

105

Al

NaOH**I-126**

Aluminum powder added to aqueous solution of pure sodium hydroxide reacts vigorously at first with considerable frothing. In a short while the frothing ceases and the reaction proceeds quietly.



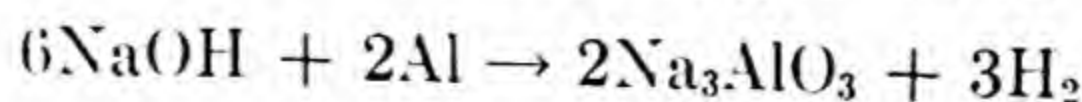
J. K. Wood, *J. Chem. Soc., London*, **93**, 420 (1908)

57

Al

NaOH**I-127**

Caustic soda and aluminum filings plus water give heat of 700 B.T.U. per pound of mixture. Used in defrosting oil wells.



W. P. Campbell, *Can. Min. & Met. Bull.* No. 213, 163 (1930)

15

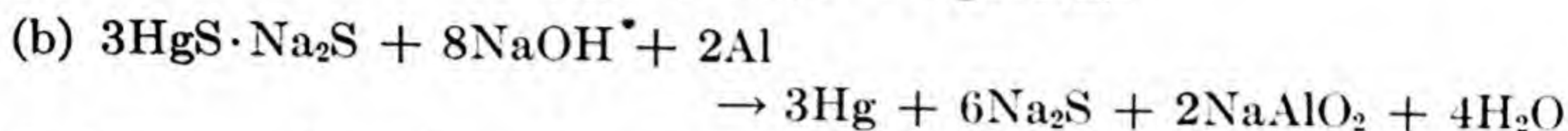
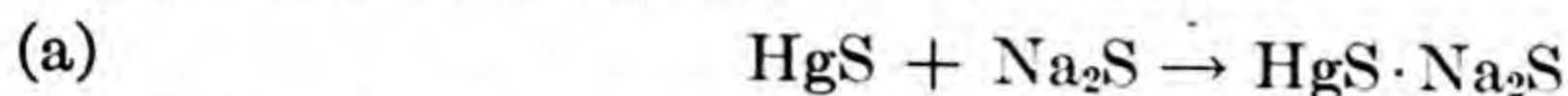
Al

NaOH

I-128

HgS

Metallic mercury is recovered from mercuric sulfide by leaching with caustic soda and sodium sulfide solution.



C. Spearman, *Can. Chem. Met. Eng.*, **9**, 57 (1925)

15

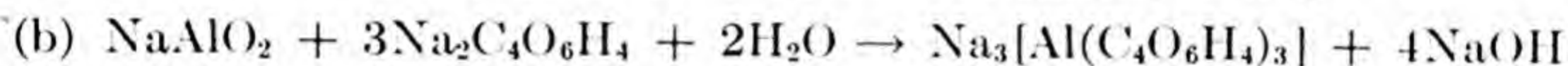
Al

NaOH

I-129

Na₂C₄O₆H₄

When metallic aluminum is dissolved in an alkaline solution of sodium tartrate, a complex is formed in solution:



Yeu Ki Heng, *J. chim. phys.*, **33**, 356 (1936)

69

Al

NaOH

I-130

Na₂S₂O₃

The reduction of sodium thiosulfate by aluminum in sodium hydroxide solution does not yield all the sulfur as the sulfide. The reaction is as follows:



Gustave Heinemann and Henry W. Rahn, *Ind. Eng. Chem., Anal. Ed.*, **9**, 458 (1937)

44

Al

Na₂OsO₄

I-131

Elementary osmium separates quantitatively when an alkaline solution of sodium osmate is treated with aluminum.



Leydie and Quennessen, *Bull. Soc. Chim. [3]*, **29**, 805 (1903)

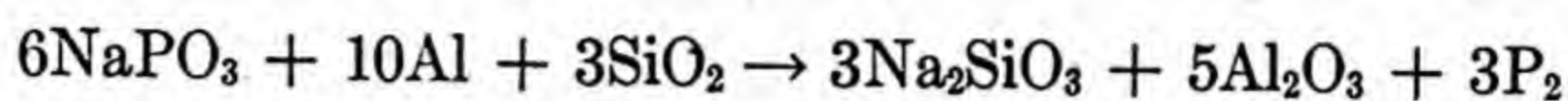
Ref., Paal and Amberger, *Ber.*, **40**, 1378 (1907)

25

Al

NaPO₃ + SiO₂**I-132**

Phosphorus is formed along with a mixture of aluminum oxide and sodium silicate when a mixture of aluminum, sand and sodium metaphosphate is heated to redness.



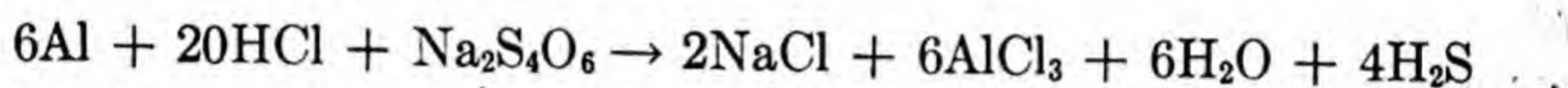
Rossel and Frank, Ber., 27, 52 (1894)

25

Al

Na₂S₄O₆**I-133**

Sodium tetrathionate is reduced by hydrogen, made by the action of aluminum on hydrochloric acid.



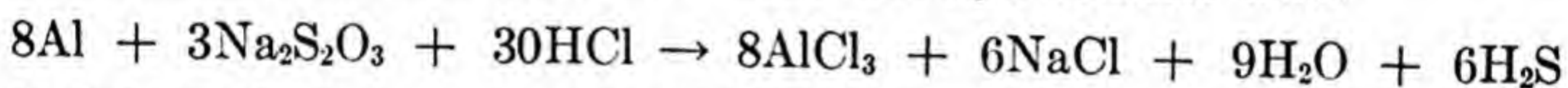
Karl Jellinek, Z. anorg. Chem., 70, 93 (1911)

25

Al

Na₂S₂O₃ + HCl**I-134**

Hydrogen sulfide is evolved quantitatively when a solution of sodium thiosulfate is treated with aluminum and hydrochloric acid.



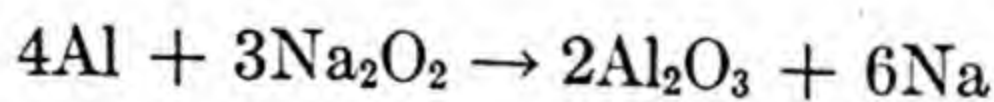
P. Dobiner, Z. anal. Chem., 46, 737 (1907)

25

Al

Na₂O₂**I-135**

Metallic sodium is obtained when a mixture of four parts of aluminum powder and three parts of sodium peroxide is set off with a drop of water. The reaction is violent in the air, but proceeds more slowly in a vacuum.



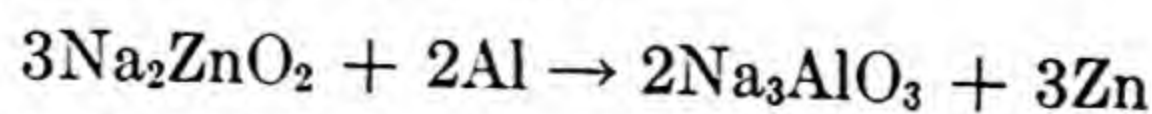
Frank E. Weston and H. R. Ellis, Chem. News, 102, 161 (1910)

25

Al

Na₂ZnO₂**I-136**

Metallic aluminum reacts with a solution of sodium zincate to form metallic zinc and sodium aluminate.



A. Cossa, Atti. dell. Instituto Veneto [III], 5, 51

Ref., A. Lieben, Ber., 3, 204 (1870)

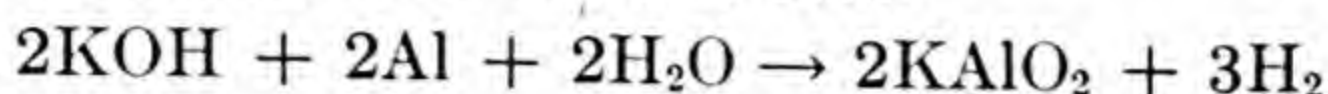
11

Al

KOH

I-137

Potassium meta-aluminate is formed when aluminum is dissolved in an excess of ten percent aqueous potassium hydroxide and the solution evaporated in a vacuum over sulfuric acid.



Allen and Rogers, Am. Chem. J., **24**, 304 (1900)

Ref., J. Chem. Soc., (London), **78**, 727 (1900)

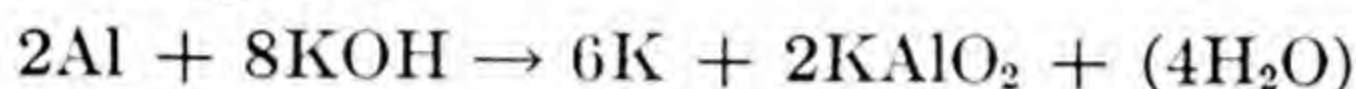
25

Al

KOH

I-138

Metallic potassium is formed when a mixture of aluminum and water free potassium hydroxide is heated in a nickel crucible at 550° (in an atmosphere of nitrogen).



Beketow, Ber., **21**, 425 (1888); Ber. 161 (1863)

Ref., Le Blanc and Weyl, Ber., **45**, 2305 (1912)

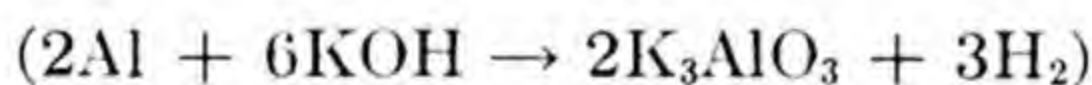
25

Al

KOH

I-139

Hydrogen can be prepared by treating heated potassium hydroxide with aluminum.



J. P. Cooke and P. W. Richards, Am. Chem. J., **10**, 104 (1888)

17

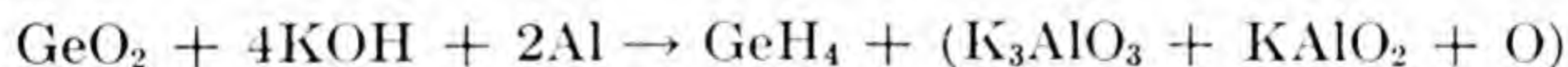
Al

KOH

I-140

GeO₂

A small quantity of germanium hydride is obtained when germanium dioxide in potassium hydroxide is treated with metallic aluminum in excess.



Dennis, Corey and Moore, J. Am. Chem. Soc., **46**, 658 (1924)

1

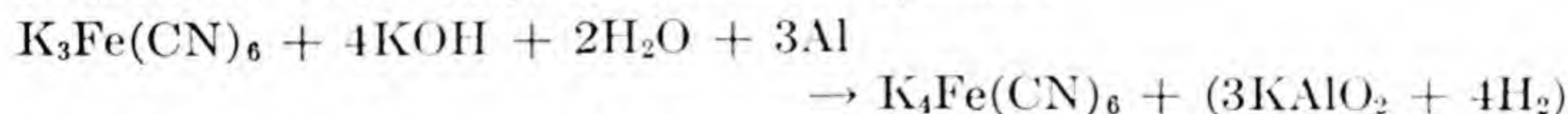
Al

KOH

I-141

K₃Fe(CN)₆

Caustic potash and aluminum filings added to potassium ferricyanide reduces the latter to potassium ferro cyanide.



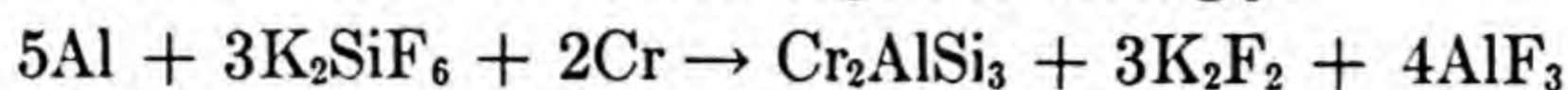
L. E. Preiss, Am. Chem. J., **28**, 240 (1902)

13

Al

K₂SiF₆ + Cr**I-142**

A double aluminum silicide is formed when aluminum, potassium fluosilicate and chromium are heated together strongly.



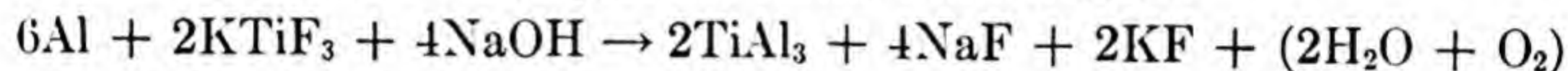
Manchot and Kieser, *Ann.*, **337**, 354 (1904)

25

Al

KTiF₃**I-143****NaOH**

Aluminum titanide is prepared by fusing 24 parts of potassium titanofluoride with 45.5 parts of aluminum, and gently heating with dilute sodium hydroxide. The product forms white leaflets.



W. Manchot and P. Richter, *Ann.* **357**, 140 (1907)

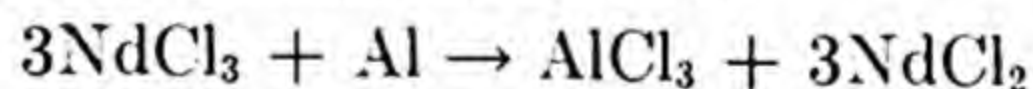
Ref., G. Young, *J. Chem. Soc.*, (London) [2] **94**, 40 (1908)

57

Al

NdCl₃**I-144**

Neodymium trichloride was reduced with aluminum by heating them together. The aluminum trichloride was formed and volatilized off with heat, leaving neodymium dichloride.



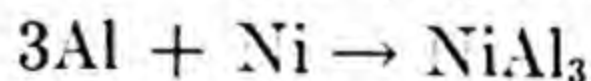
C. Matignon, *Ann. Chim. Phys.*, VIII, **8**, 420 (1906)

100

Al

Ni**I-145**

Shining, feather-like crystals were obtained when one part of nickel and six parts of aluminum were melted together under a layer of common salt and then treated with 3% hydrochloric acid.



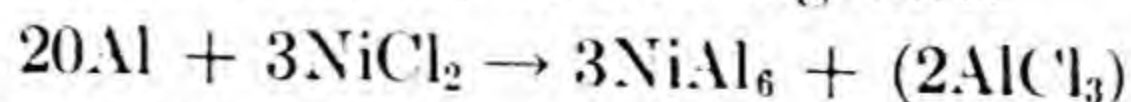
Brunck, *Ber.*, **34**, 2733 (1901)

25

Al

NiCl₂**I-146****(NaCl)**

Large white crystalline leaves are prepared when aluminum, nickel chloride and sodium chloride are melted together.



H. Michel, *Ann.*, **115**, 104 (1860)

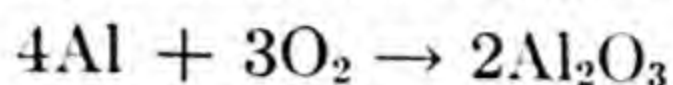
25

Al

O₂

I-147

When a well amalgamated piece of aluminum is vigorously rubbed with soft leather, it heats up and forms aluminum oxide on the surface. Unamalgamated aluminum does not show this reaction.



Carl Jehn and H. Hinze, Ber., 7, 1498 (1874)

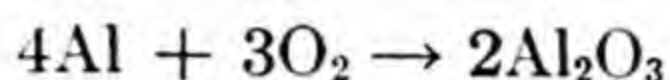
11

Al

O₂ + E

I-148

Anodic oxidation of metallic aluminum forms aluminum oxide.



H. Sutton and J. W. Willstrop, J. Inst. Metals, 1927

Ref., Can. Chem. & Met., 11, 313 (1927)

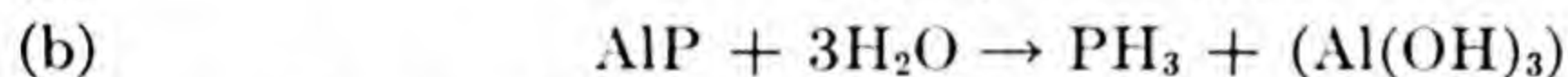
15

Al

P

I-149

Phosphine is formed when crude aluminum phosphide made by igniting a mixture of aluminum and red phosphorus is allowed to react with water.



Bodroux, Bull. Soc. Chim., (3), 27, 568 (1902)

Ref., J. Am. Chem. Soc., 25, 1284 (1903)

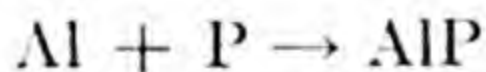
1

Al

P

I-150

Aluminum phosphide is formed when an intimate mixture of aluminum and red phosphorus is ignited.



Fonzes-Diacon, Compt. rend., 130, 1314 (1900)

Ref., J. Chem. Soc., 78, 405 (1900)

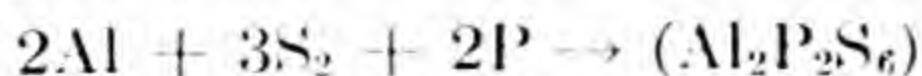
11

Al

P + S

I-151

An aluminum thiohypophosphate was obtained as a brownish white crystalline mass when a mixture of aluminum, sulfur and red phosphorus was heated in a tube.



Friedel, Compt. rend., 119, 260

Ref., Ber., 27, 623 (1894)

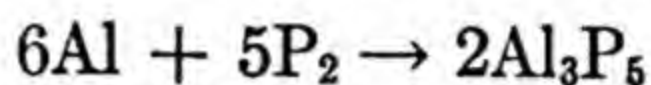
25

Al

P

I-152

An aluminum phosphide is obtained when phosphorus vapors are passed over aluminum at a high temperature.



Rossel and Frank, Ber., 27, 52 (1894)

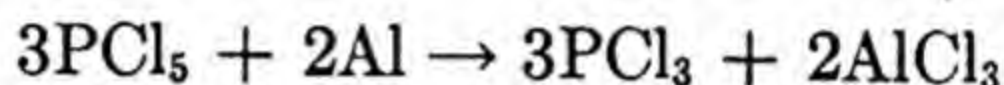
25

Al

PCl₅

I-153

Aluminum and phosphorus pentachloride combine vigorously when heated together. Phosphorus trichloride and aluminum chloride are formed if the latter is allowed to distill.



E. Baudrimont, Ann. d. Chim. Phys. (4), 2, 15 (1864)

70

Al

PCl₅

I-154

Phosphorus pentachloride acts on aluminum to form aluminum chlorophosphate.



E. Baudrimont, Compt. rend., 55, 363 (1862)

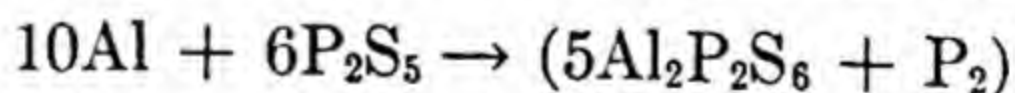
29

Al

P₂S₅

I-155

An aluminum thiohypophosphate is formed when phosphorus pentasulfide is heated with aluminum in a combustion tube.



Friedel, Compt. rend., 119, 260

Ref., Ber., 27, 623 (1894)

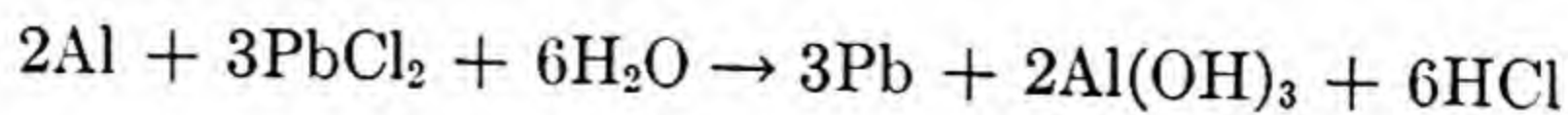
25

Al

PbCl₂

I-156

Metallic aluminum quickly reacts with a solution of lead chloride to form metallic lead.



A. Cossa,

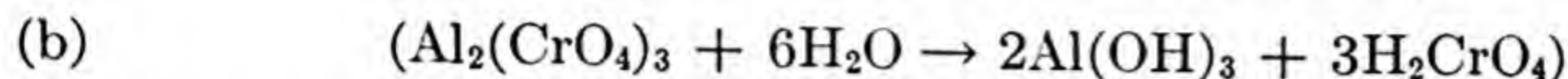
Ref., A. Lieben, Ber., 3, 204 (1870)

11

Al

PbCrO₄**I-157**

Metallic aluminum reacts with an alkaline solution of lead chromate to form metallic lead and chromic acid.



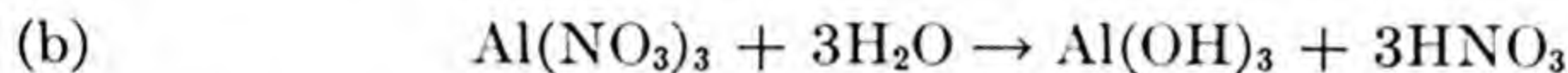
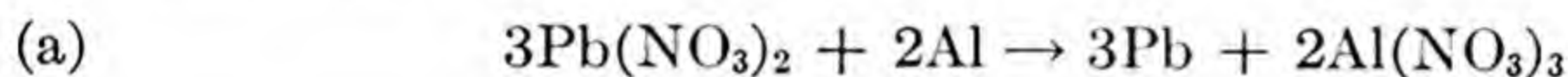
A. Cossa,
Ref., A. Lieben, Ber., **3**, 204 (1870)

11

Al

Pb(NO₃)₂**I-158**

Metallic aluminum slowly reacts with a solution of lead nitrate with the formation of metallic lead.



A. Cossa,
Ref., A. Lieben, Ber., **3**, 204 (1870)

11

Al

PbS**I-159**

Fill a crucible with pulverized lead sulfide, put powdered aluminum on top and melt. Pour in forms and let cool. The bottom layer is lead, the medium layer is the excess aluminum and the top layer is aluminum sulfide.



Cl. Th. J. Vautin, Germ. Pat. 75825
Ref., Z. angew. Chem., **7**, 359 (1894)

34

Al

S**I-160**

Aluminum sulfide is prepared by fusing aluminum with sulfur and igniting with magnesium ribbon.



Biltz, Z. Anorg. Chem., **71**, 182,427 (1911)
Ref., J. S. Howe, J. Am. Chem. Soc., **34**, 147 (1912)

1

Al

S

I-161

Even at red heat aluminum and sulfur react very slowly. But when a fuse of potassium chlorate and sulfur is used the reaction proceeds with explosive violence.



H. Danneel and K. W. Fröhlich, *Z. Angew. Chem.*, **40**, 809 (1927)

34

Al

S

I-162

Powdered aluminum reacts with flowers of sulfur in the presence of magnesium oxide. The reaction takes place at high temperatures to give a good yield and a moderately active reaction.



Fonzes and H. Deacon, *Bull. Soc. Chim.*, **1**, 36 (1907)

31

Al

S

I-163

Aluminum sulfide is formed when a mixture containing equivalent proportions of precipitated sulfur and fine aluminum powder is ignited.



Fonzes-Deacon, *Compt. rend.*, **130**, 1314 (1900)

Ref., *J. Chem. Soc.*, **78**, 405 (1900)

1

Al

S

I-164

Δ

By fusing together aluminum and sulfur, dialuminum trisulfide is obtained. After heating this compound to 2100° for 20 minutes, aluminum monosulfide will result.



W. Biltz and F. Caspari, *Z. anorg. Chem.*, **71**, 182 (1911)

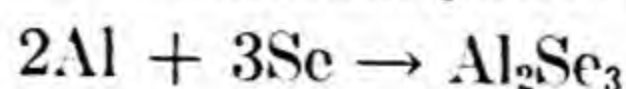
28

Al

Se

I-165

Aluminum selenide is formed when a mixture containing equivalent proportions of selenium and aluminum powder is ignited.



Fonzes-Deacon, *Compt. rend.*, **130**, 1314 (1900)

Ref., *J. Chem. Soc.*, **78**, 405 (1900)

2

Al

Se

I-166

A mixture of 1 to 4.4 of powdered aluminum and selenium metals reacts readily upon heating to form aluminum selenide.



J. Papish, *J. Phys. Chem.*, **22**, 642 (1918)

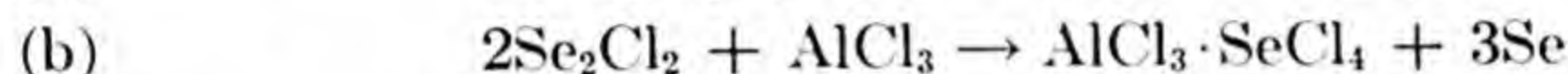
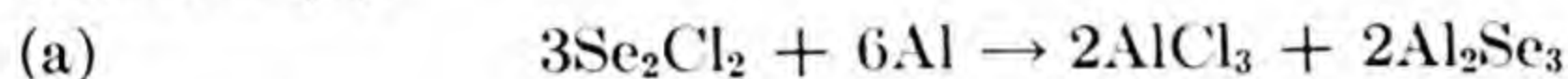
85

Al

Se₂Cl₂

I-167

Selenium monochloride does not react with aluminum at room temperature, but at 80° the reaction is vigorous (a). When the monochloride is in excess a double compound is formed together with free selenium (b).



V. Lenher and C. H. Kao, *J. Am. Chem. Soc.*, **48**, 1553 (1926)

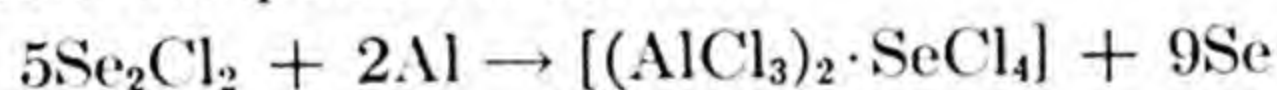
25

Al

Se₂Cl₂

I-168

When aluminum and selenium monochloride are heated together for 12 hours a double compound is formed.



Weber, *Pogg. Ann.*, **104**, 427 (1858)

Ref., Lenher and Kao, *J. Am. Chem. Soc.*, **48**, 1553 (1926)

1

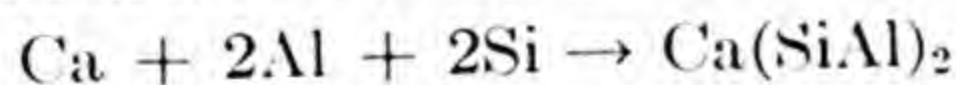
Al

Si

I-169

Ca

Calcium aluminum silicide is prepared when metallic calcium reacts with a mixture of silicon and aluminum.



Reynolds, *Proc. Roy. Soc., (A)*, **88**, 37

Ref., J. L. Howe, *J. Am. Chem. Soc.*, **36**, 237 (1914)

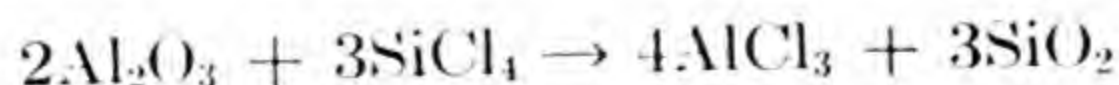
1

Al

SiCl₄

I-170

Aluminum chloride and silicon dioxide are formed when aluminum oxide and silicon tetrachloride are heated together to 270°–280°C. in a melting tube.



von Gustav Rauter, *Ann.*, **270**, 249 (1892)

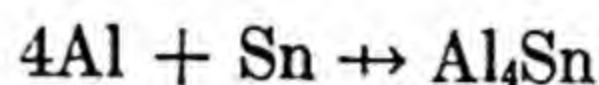
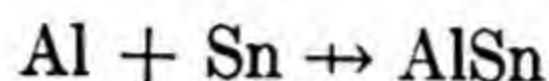
25

Al

Sn

I-171

A careful analysis of freezing point relations shows that the following compounds are not formed in alloy systems of aluminum and tin. Solid solutions however, are formed in these systems. This information contradicts and corrects the reports found in the literature.



E. S. Shepherd, *J. Phys. Chem.*, **8**, 233 (1904)

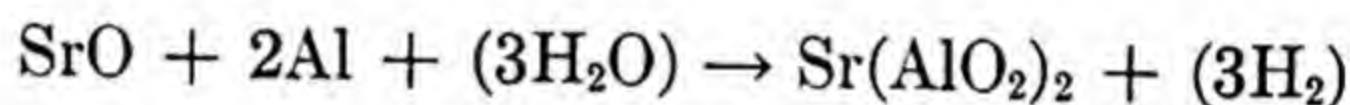
7

Al

SrO

I-172

Strontium meta-aluminate is formed when strontium oxide reacts with aluminum.



Allen and Rogers, *Am. Chem. J.*, **24**, 304 (1900)

Ref., *J. Chem. Soc.*, (London), **78**, 727 (1900)

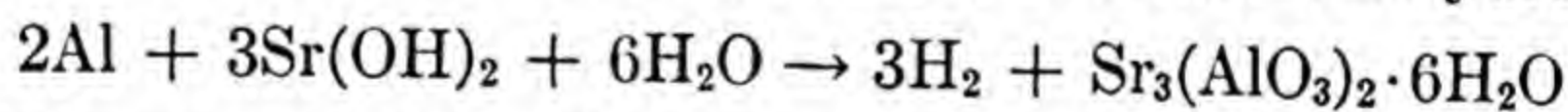
25

Al

Sr(OH)₂

I-173

Slightly brown crystals of strontium aluminate are formed when aluminum is boiled with a strong solution of strontium hydroxide.



Allen and Rogers, *Am. Chem. J.*, **24**, 304 (1900)

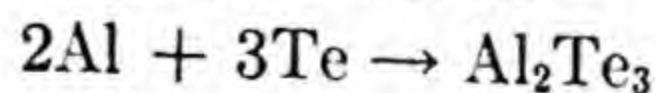
25

Al

Te

I-174

A mixture of 1 to 7 of powdered aluminum and tellurium metals reacts, after heating, to form aluminum telluride.



J. Papish, *J. Phys. Chem.*, **22**, 643 (1918)

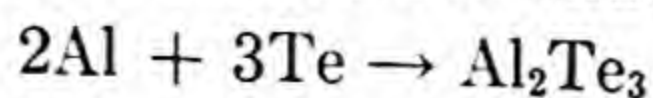
85

Al

Te

I-175

Tellurium when heated with aluminum combines with explosive violence, forming a chocolate colored aluminum telluride.



Chikashige and Nose, *J. Chem. Soc.*, **114**, 114 (1918)

Ref., C. Whitehead, *J. Am. Chem. Soc.*, **17**, 854 (1895)

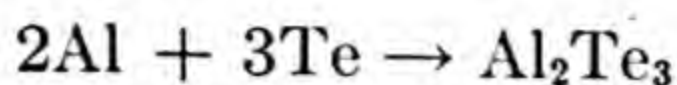
1

Al

Te

I-176

Aluminum telluride is formed when aluminum and tellurium are heated together.



Chikashige and Nose, Mem. Coll. Sci. Kyoto, **2**, 227 (1917)

Ref., J. Chem. Soc. (London), **114**, 114 (1918)

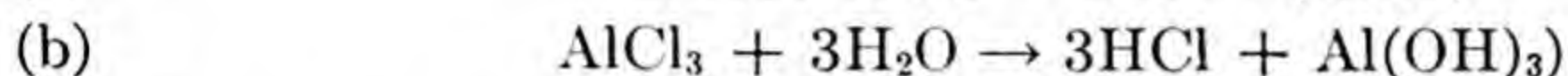
25

Al

TlCl

I-177

Metallic aluminum reacts with a solution of thallous chloride at 90°C. to form metallic thallium.



A. Cossa,

Ref., A. Lieben, Ber., **3**, 204 (1870)

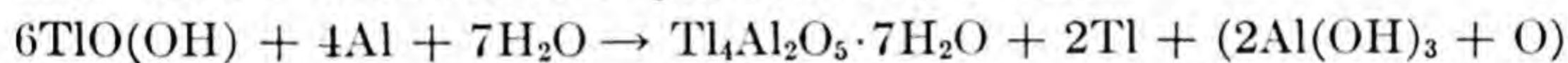
11

Al

TlO(OH)

I-178

A white powdery mass of thallium aluminate precipitates when the very last of a solution of aluminum in basic thallium oxide evaporates in a vacuum desiccator over potassium hydroxide.



L. F. Hawley, J. Am. Chem. Soc., **20**, 302 (1907)

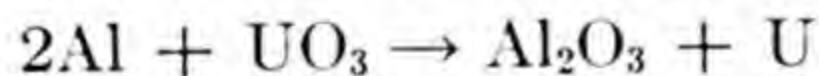
1

Al

UO₃

I-179

Aluminum oxide and uranium are obtained by gently igniting a mixture containing uranium trioxide and an excess of aluminum.



Stavenhagen, Ber., **32**, 3065 (1899)

25

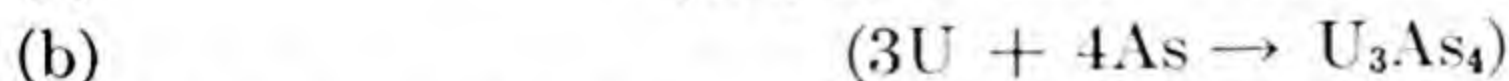
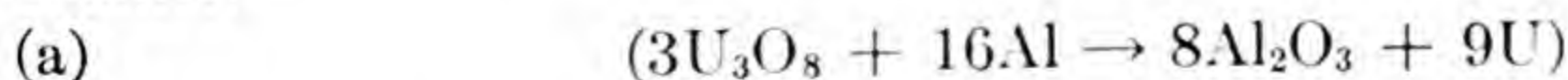
Al

U₃O₈

I-180

As

Uranium octoxide was placed in a crucible containing powdered aluminum and arsenic. The crucible was heated and aluminum oxide and uranium arsenide were formed, (b). Antimony reacts in the same manner.



A. Colani, Ann. Chim. Phys., VIII, **12**, 93 (1907)

100

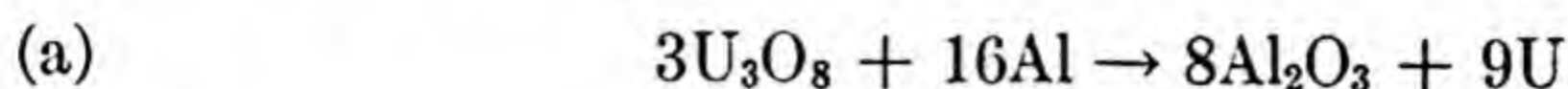
Al

 U_3O_8

I-181

P

Uranium octoxide was placed in a crucible containing powdered aluminum and red phosphorus. The crucible was heated and aluminum oxide and uranium phosphide were formed.



A. Colani, *Ann. Chim. Phys.* [VIII], **12**, 90 (1907)

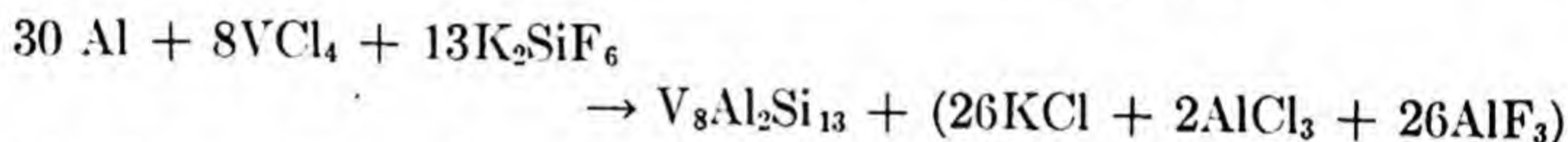
100

Al

 $\text{VCl}_4 + \text{K}_2\text{SiF}_6$

I-182

Vanadium aluminum silicide is obtained in the form of gray white hexagonal crystals of high luster when vanadium tetrachloride, aluminum and potassium fluosilicate are melted together.



Manhot and Kieser, *Ann.*, **337**, 353 (1904)

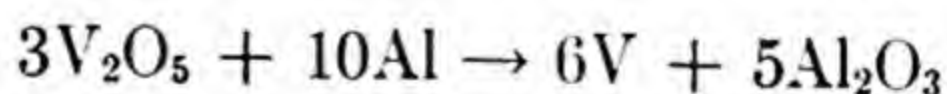
25

Al

 V_2O_5

I-183

When vanadium pentoxide is reduced with metallic aluminum about 79% vanadium is obtained.



Marden and Rich, *Ind. Eng. Chem.*, **19**, 786 (1927)

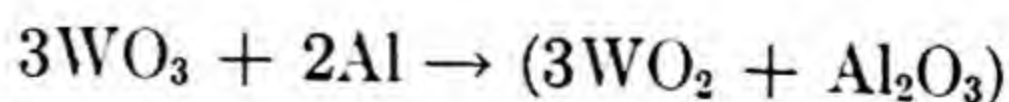
24

Al

 WO_3

I-184

Tungsten trioxide is reduced at full red heat when intimately mixed in molecular quantities with aluminum powder with the probable formation of tungsten dioxide.



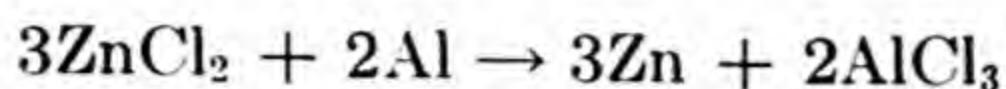
C. H. Ehrenfeld, *J. Am. Chem. Soc.*, **17**, 393 (1895)

1

Al

ZnCl₂**I-185**

Metallic aluminum reduces anhydrous zinc chloride to the metal and forms aluminum chloride.



F. Flavitsky,

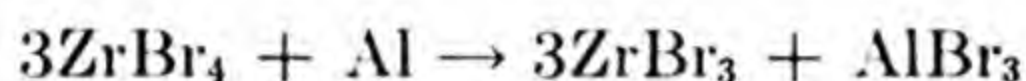
Ref., Felix Wreden, Ber., **6**, 195 (1873)

11

Al

ZrBr₄**I-186**

Zirconium tribromide is formed when vapors of zirconium tetrabromide mixed with hydrogen are passed over an aluminum coil heated to 450° in an electric furnace.



R. C. Young, J. Am. Chem. Soc., **53**, 2148 (1931)

1

AlAs₃Cl₃**Δ****I-187**

Aluminum triarsenic trichloride decomposes upon heating forming aluminum arsenide.

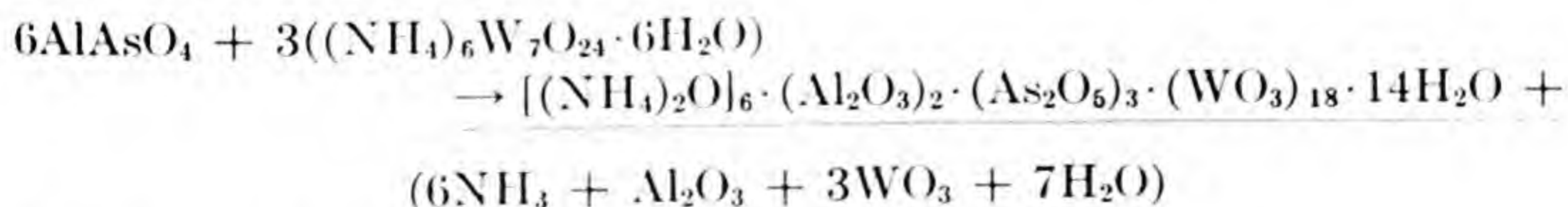


Ruff and Staib, Zeit. Anorg. Chem., **117**, 200 (1921)

1

AlAsO₄**(NH₄)₆W₇O₂₄·6H₂O****I-188**

Ammonium aluminum arsenotungstate is precipitated when a solution of ammonium paratungstate is boiled with a semisolution of aluminum arsenate in ammonia.



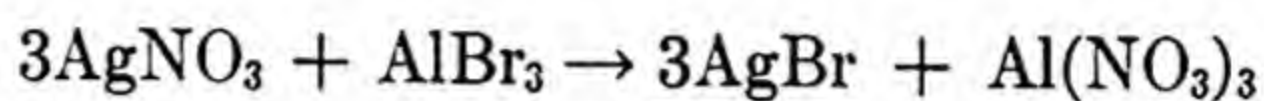
L. C. Daniels, J. Am. Chem. Soc., **30**, 1854 (1908)

1



I-189

A silver nitrate solution was added to an aqueous solution of aluminum bromide. Silver bromide precipitated.



J. W. Mallette, Trans. Roy. Soc. (London), **171**, 1003 (1881)

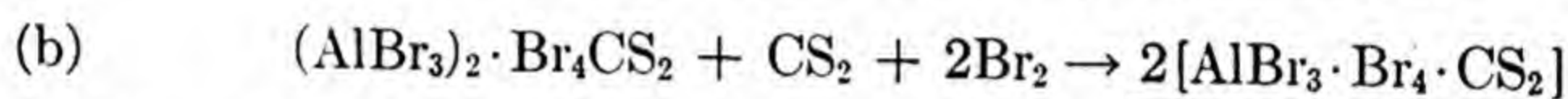
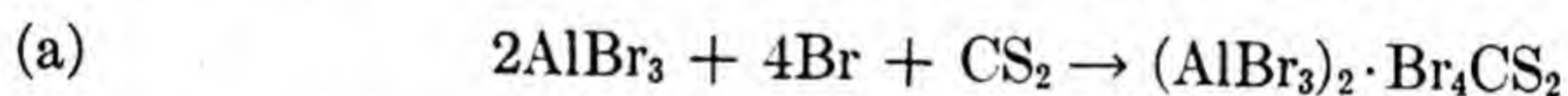
105



I-190

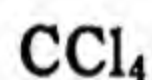


A solution of bromine in carbon disulfide is added to a solution of aluminum bromide in carbon disulfide. An oil-like substance of dark red color is obtained. By adding more bromine crystals will result.



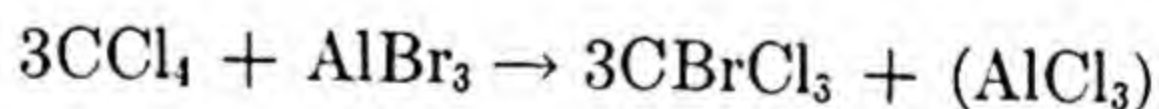
W. Plotnikow, Z. anorg. Chem., **31**, 127 (1902)

28



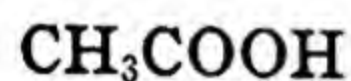
I-191

Bromotrichloromethane was prepared by treating carbon tetrachloride with aluminum bromide and allowing to stand at room temperature for three days.

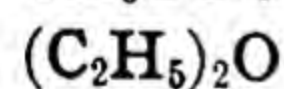


Vesper and Rollefson, J. Am. Chem. Soc., **56**, 1456 (1934)

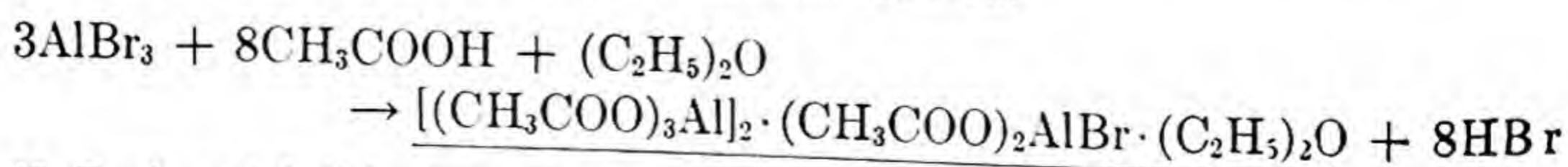
1



I-192



To aluminum bromide (9.5 g.) 20 ml. of acetic acid (100%) are added. After heating for 3 hours and after it has cooled off, ether is added. Colorless crystals of a complex salt are formed.



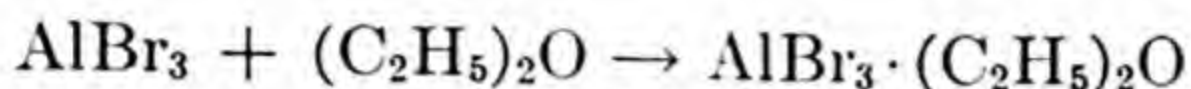
H. Funk and J. Schormüller, Z. anorg. Chem., **199**, 93 (1931)

28



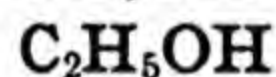
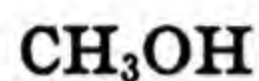
I-193

Aluminum bromide will react with ether yielding colorless crystals, a complex compound.



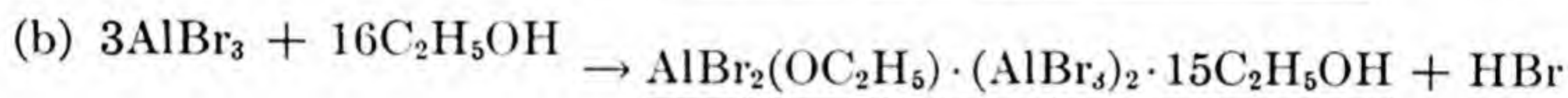
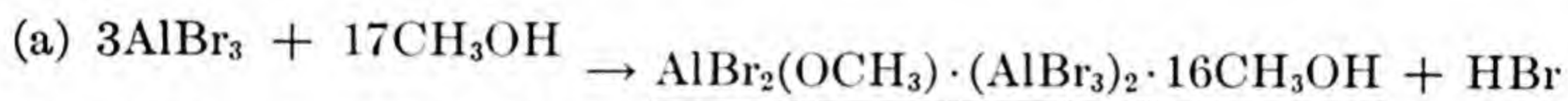
W. A. Plotuikow, Z. anorg. Chem., **56**, 53 (1908)

28



I-194

To 20 ml. of methyl alcohol an almost saturated solution of aluminum bromide in carbon disulfide is added. By adding 10–15 ml. of ether colorless crystals are formed. The same type reaction occurs with ethyl alcohol.



H. Funk, J. Schormüller and W. Hensinger, Z. anorg. Chem., **205**, 361 (1932)

28



I-195

Carbonyl chloride reacts with molten aluminum bromide at 100°.



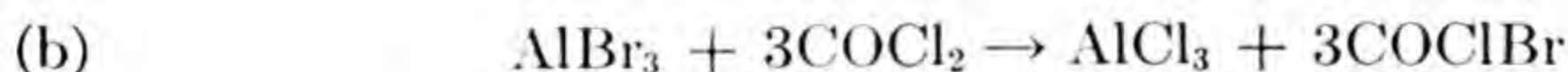
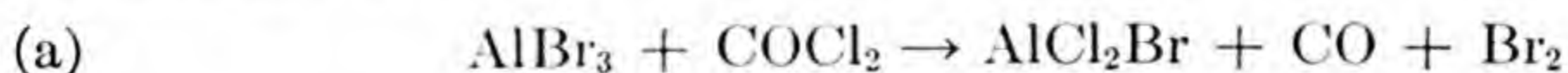
A. von Bartsch, Z. Anorg. Chem., **55**, 152 (1907)

25



I-196

Aluminum bromide will react with carbonyl chloride. When aluminum bromide is in excess aluminum chlorobromide is formed. When carbonyl chloride is in excess aluminum chloride and carbonyl chlorobromide are obtained.



A. v. Bartsch, Z. anorg. Chem., **55**, 152 (1907)

28

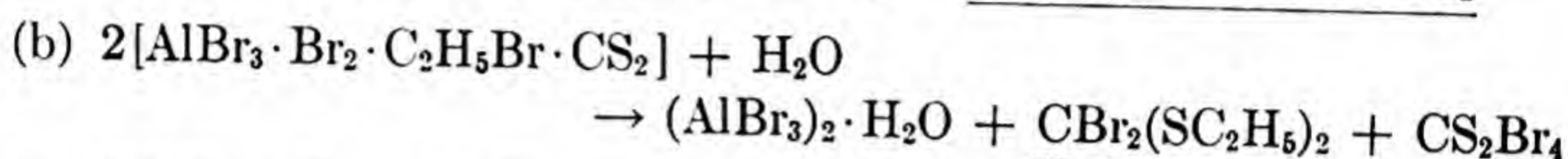
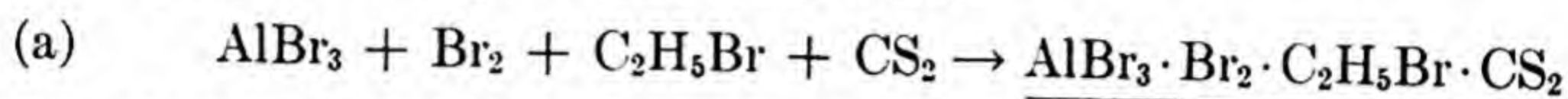
AlBr₃CS₂

Br

C₂H₅Br

I-197

A saturated solution of aluminum bromide in carbon disulfide will react with a solution of bromine in ethyl bromide yielding yellow crystals of a complex nature, hydrolyzes with water.



W. Plotnikow, Z. anorg. Chem., **38**, 132 (1904)

28

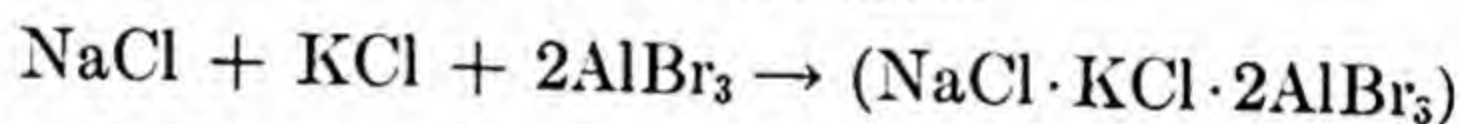
AlBr₃

KCl

NaCl

I-198

Potassium chloride and sodium chloride were mixed in equimolecular proportions and fused. This was added to fused aluminum bromide. Much heat was given off. Equimolecular proportions of the two chlorides and aluminum bromide were used.



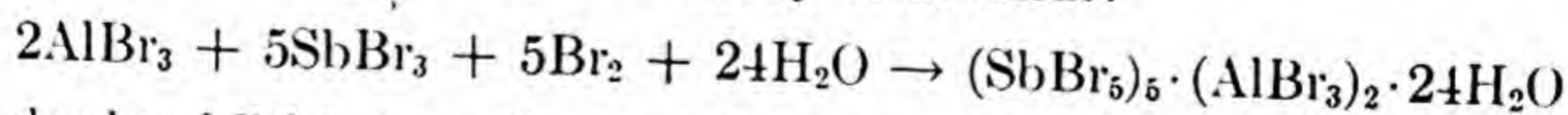
J. W. Mallette, Trans. Roy. Soc. (London), **171**, 1003-35 (1881)

105

AlBr₃SbBr₃Br₂

I-199

Black, shiny, thick prisms of antimony pentabromide-aluminum bromide are obtained when an excess of bromine is added to a solution of aluminum bromide and antimony tribromide.



Weinland and Feige, Ber., **36**, 244 (1903)

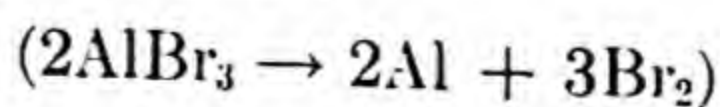
1

AlBr₃

e

I-200

Aluminum can be deposited electrolytically from solutions of aluminum bromide in ethyl bromide.



W. A. Plotnikoff, J. Russ. Phys. Chem. Soc. [3], 466 (1902)

Ref., H. E. Patten, J. Phys. Chem., **8**, 548 (1904)

7

AlBr₃

I-201

ε
Δ

The band spectrum produced by a high frequency discharge, maintained by a 500 watt oscillator working at about 10⁷ cycles per second, in aluminum bromide vapor indicates the presence of the diatomic molecule AlBr. The discharge has a deep blue color.



H. G. Howell, Proc. Roy. Soc. (London) **148A**, 696 (1935)

110

Al₂Br₆

I-202

Δ

Partly hydrated aluminum bromide is decomposed when heated, giving off hydrogen bromide. A mixture of the fully hydrated salt with some anhydrous bromide yields hydrogen bromide and aluminum oxide.



Gustavson, J. prakt. Chem., **63**, 110 (1901)

Ref., J. Murray, J. Chim. phys., **15**, 334 (1917)

69

Al Br₃·Br₄·CS₂

I-203

H₂O

The aluminum bromide-bromine-carbon disulfide compound of the above formula will be decomposed by water yielding aluminum bromide and carbotrithiohexabromide crystals.



W. Plotnikow, Z. anorg. Chem., **31**, 127 (1902)

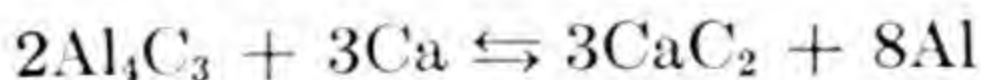
28

Al₄C₃

I-204

Ca

Reaction between aluminum carbide and calcium occurs at all temperatures above the melting point of calcium. The conversion of aluminum carbide into calcium carbide and aluminum is less complete as the temperature rises.

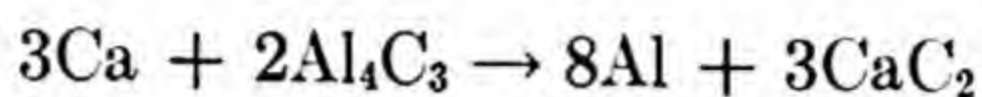


J. N. Pring, J. Chem. Soc. (London), **87**, 1539 (1905)

102

**Ca****I-205**

At the temperature of melting calcium, this element will reduce aluminum carbide to the extent of 83%. At 1400°C. the reduction is only about 7%.

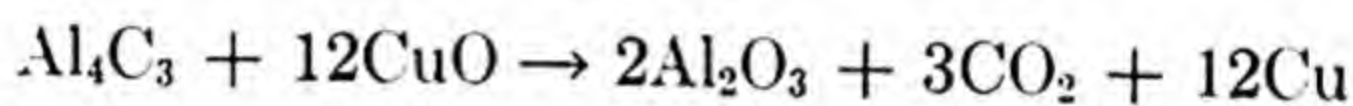


J. N. Pring, J. Chem. Soc., (London), **87**, 1530 (1905)

13

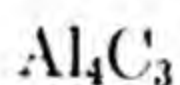
**CuO****I-206**

Aluminum carbide reacts with copper oxide at a temperature above a red heat to produce alumina and carbon dioxide. A similar reaction takes place with the oxides of lead.

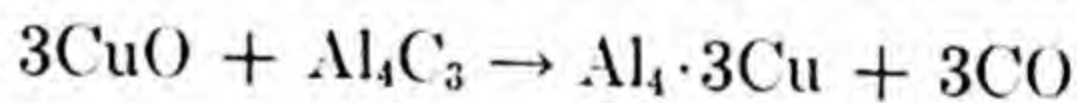


J. N. Pring, J. Chem. Soc. (London), **87**, 1533, (1905)

13, 103, 102

**CuO****I-207**

If aluminum carbide and copper oxide are heated above 1400°, an aluminum-copper alloy and carbon monoxide are formed.

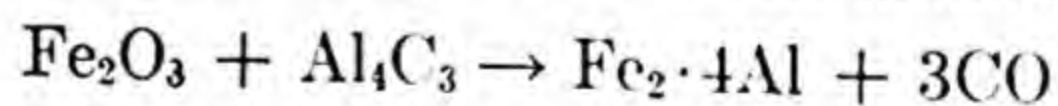


J. N. Pring, J. Chem. Soc. (London), **87**, 1539 (1905)

102

**Fe₂O₃****I-208**

At temperatures above 1400°, aluminum carbide and ferric oxide unite to form an iron-aluminum alloy and carbon monoxide.

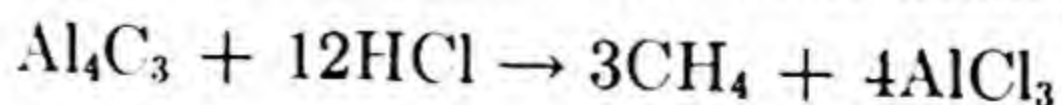


J. N. Pring, J. Chem. Soc. (London), **87**, 1540 (1905)

102

**HCl****I-209**

Methane is formed when aluminum carbide is decomposed by acids.

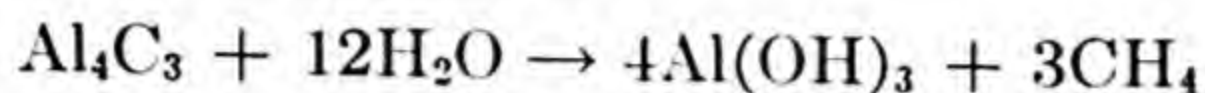


E. Briner and R. Senglet, J. Chim. phys., **13**, 351 (1915)

69

**H₂O****I-210**

Aluminum carbide is decomposed by the action of water to produce pure methane and aluminum hydroxide.



Pietro Bartolotti, *Gazz. Chim. Ital.*, **27**, 337 (1897)

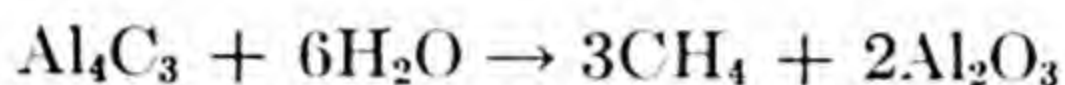
H. Kraemer, *J. Am. Chem. Soc.*, **21**, 650 (1899)

21

1

**H₂O****I-211**

Aluminum carbide reacts with water to produce methane and aluminum oxide.

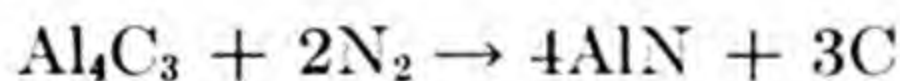


J. H. Caps, *J. Ind. Eng. Chem.*, **13**, 810 (1921)

22

**N₂****I-212**

Aluminum nitride is formed when aluminum carbide is heated in an atmosphere of nitrogen.

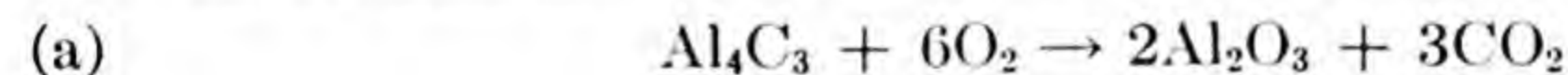


Fr. Fichter *Zeit. Anorg. Chem.*, **54**, 322 (1907)

25

**O₂****I-213**

Heated in air, aluminum carbide decomposes according to equation (a). In vacuum the decomposition is reversible, (b).

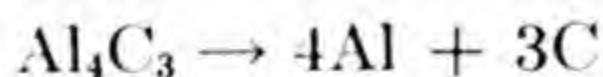


E. Briner and R. Senglet, *J. Chim. phys.*, **13**, 351 (1915)

69

**Δ****I-214**

Amorphous aluminum carbide is decomposed at temperatures around 1200°.

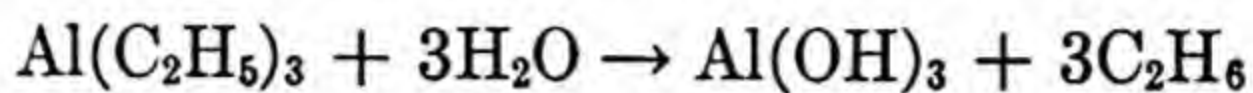


L. Wöhler and K. Hofer, *Z. anorg. Chem.*, **213**, 249 (1933)

28

**H₂O****I-215**

Aluminum hydroxide is formed when a solution of triethyl aluminum in absolute alcohol is added to water or when a stream of dry nitrogen gas mixed with triethyl aluminum is passed through water.

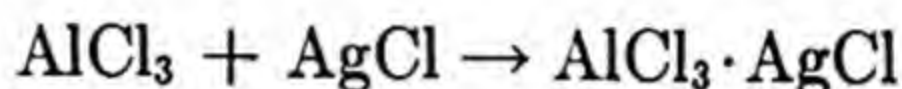


P. A. Thiessen and K. L. Thater, *Z. anorg. Chem.*, **181**, 417 (1929)

28

**AgCl****I-216**

Aluminum chloride fused with silver chloride forms the compound aluminum silver chloride.

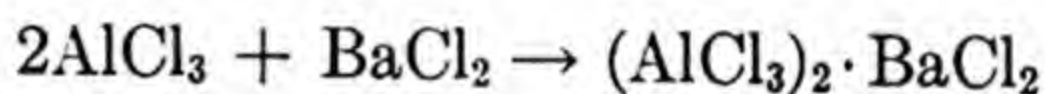


M. E. Band, *Ann. chim. phys. [VIII]*, **1**, 50 (1904)

100

**BaCl₂****I-217**

Aluminum chloride reacts with barium chloride to form the compound aluminum barium chloride.

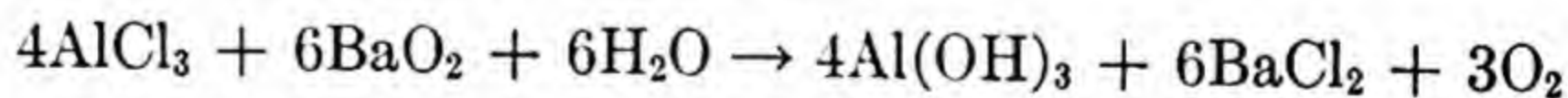


M. E. Band, *Ann. chim. phys. [VIII]*, **1**, 55 (1904)

100

**BaO₂****I-218**

Aluminum hydroxide is formed when aluminum chloride reacts with barium peroxide suspended in water.

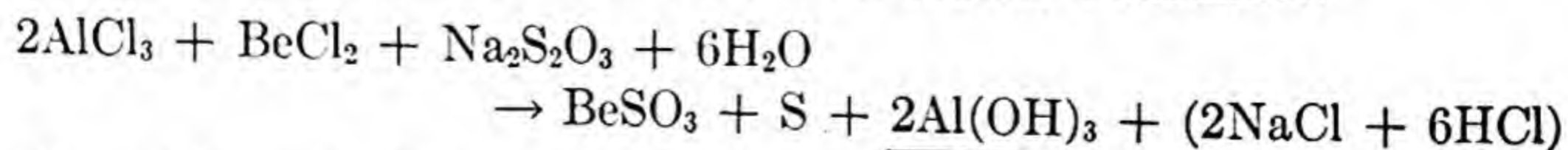


Tanatar, *Ber.*, **36**, 1893 (1903)

25

**BeCl₂ + Na₂S₂O₃****I-219**

Aluminum hydroxide precipitates when a solution containing aluminum and beryllium chlorides is treated with sodium thiosulfate.



Havens, *Z. anorg. Chem.*, **16**, 15 (1898)

Ref., Glassman, *Ber.*, **39**, 3366 (1906)

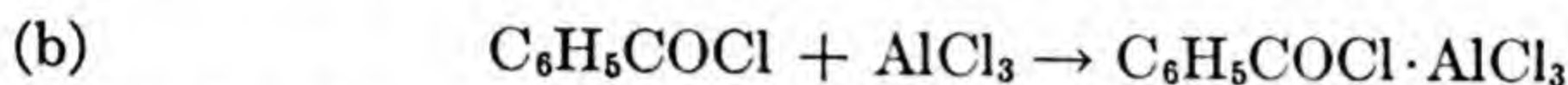
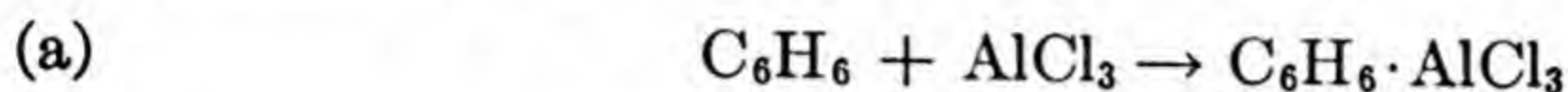
25



I-220



When aluminum chloride in pure dry form is treated with aromatic hydrocarbons such as benzene, or with benzoyl chloride, unstable addition products are obtained. The crystals formed decompose in the presence of moisture.

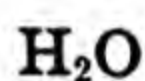


J. Boeseken, *Rec. trav. chim.*, **19**, 20, 26 (1900)

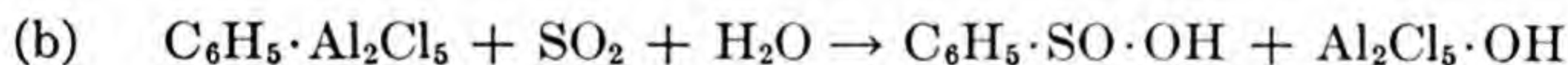
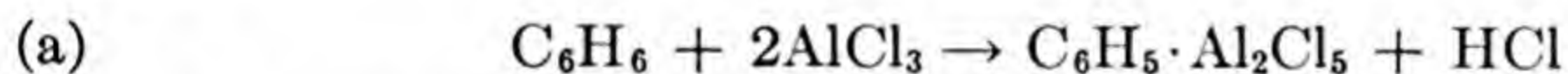
27



I-221



A mixture of benzene and aluminum chloride absorbs sulfur dioxide. By adding water to the resulting compound benzene sulphinic acid is formed.

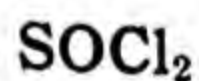


Friedel and Crafts, *Jahresberichte über die Fortschritte der Chemie-G.*, 739 (1878)
 Ref., C. Colby and McLaughlin-Am. Chem. J., **9**, 67 (1887)

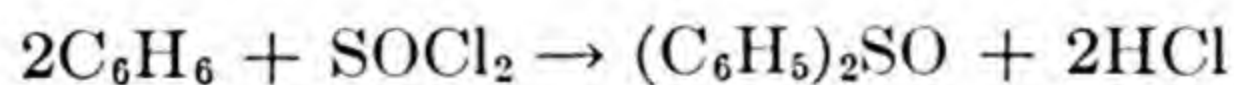
17



I-222



When benzene reacts with thionyl chloride in the presence of aluminum chloride, pure diphenyl sulfoxide is obtained.



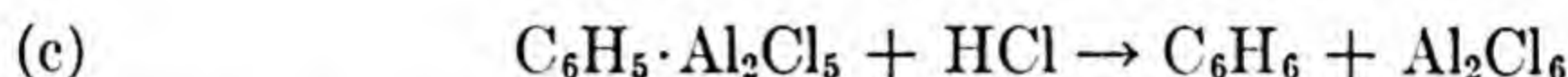
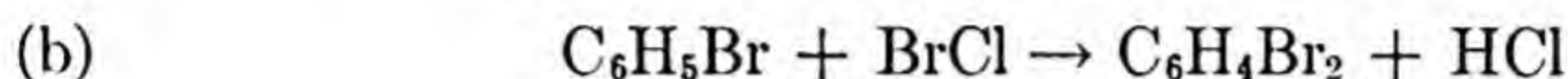
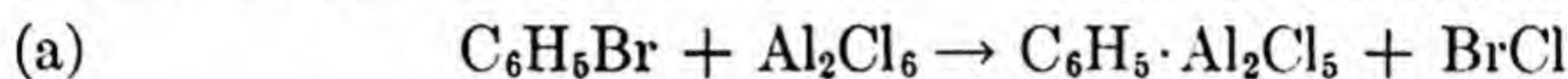
Chas. E. Colby and C. S. McLaughlin, *Am. Chem. J.*, **9**, 69 (1887)

17



I-223

The action of aluminum chloride on bromobenzene results in the formation of small quantities of benzene, dibromo-benzene and tarry matter, the greater part of the starting material remaining unchanged. The mechanism of the reaction is shown in equations (a), (b) and (c).



Dumreicher, Ber., **15**, 1867 (1882)

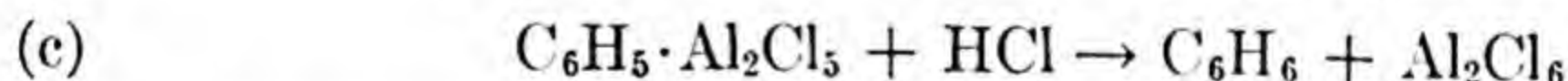
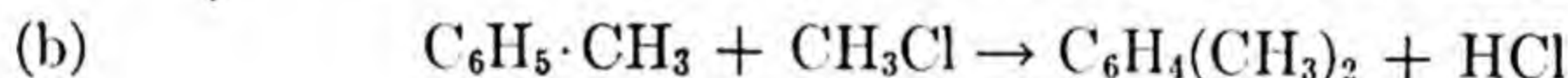
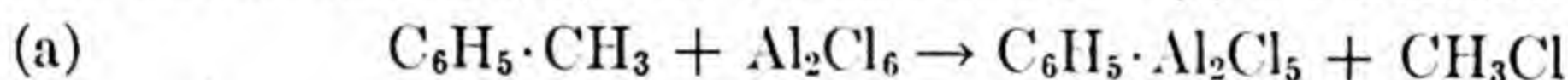
Ref., Maurice Copisarow, J. Chem. Soc., **119**, 442 (1921)

48



I-224

When a mixture of toluene and finely powdered aluminum chloride is heated on the steam bath under reflux, the resulting mixture darkens with the formation of a deep red double compound of aluminum chloride with the hydrocarbons present, (a). Upon treatment with hydrochloric acid and distillation, xylene (b) and benzene (c) are isolated.



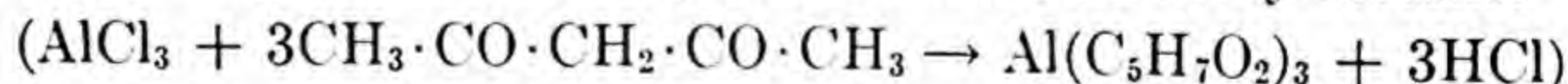
Maurice Copisarow, J. Chem. Soc., **119:2**, 1807, 1808 (1921)

48



I-225

Anhydrous aluminum chloride reacts with acetylacetone in chloroform solution, giving a quantitative yield of aluminum acetylacetone.



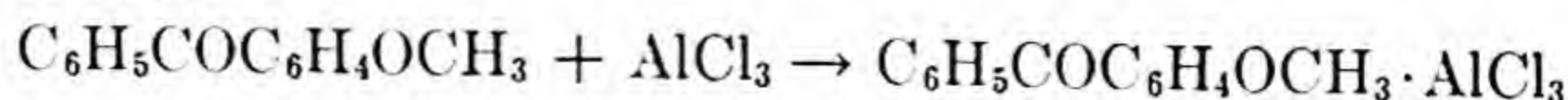
Gilbert T. Morgan and Harry D. K. Drew, J. Chem. Soc., **119**, 1060 (1921)

48



I-226

When aluminum chloride is added to a solution of methoxy benzo-phenone in pure, dry carbon bisulfide, an addition product is formed which crystallizes after the solvent has been removed by evaporation under vacuum.



J. Boeseken, Rec. trav. chim., **19**, 23 (1900)

27

CH₃COOH**I-227**

To a dispersion of aluminum chloride (8g) in 30 ml of ether a mixture of 9 ml of acetic acid (100%) and 10 ml of ether is added. White colored crystals of a complex aluminum chloride-aluminum acetate are obtained.

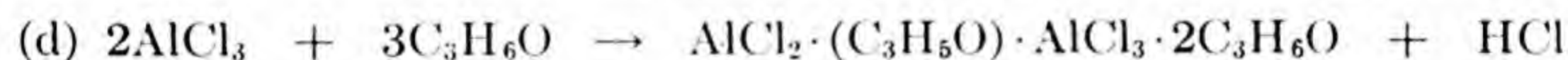
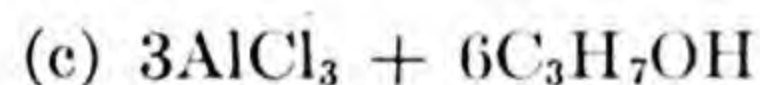
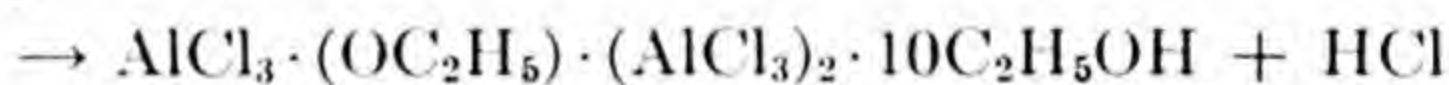


H. Funk and J. Schormüller, *Z. anorg. Chem.*, **199**, 93 (1931)

28

**CH₃OH****I-228****C₂H₅OH****C₃H₇OH****C₃H₆O**

Dissolve aluminum chloride in methyl alcohol. By adding ether, colorless crystals are formed. The same type reaction occurs with ethyl alcohol, n-propyl alcohol and acetone.

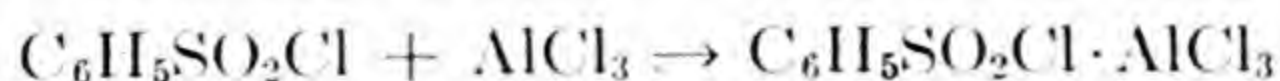


H. Funk, J. Schormüller, and W. Hensinger, *Z. anorg. Chem.*, **205**, 361 (1932)

28

**C₆H₅SO₂Cl****I-229**

When aluminum chloride is added to a solution of benzene sulfonic chloride in pure, dry carbon bisulfide, an addition product is formed which crystallizes in the absence of moisture. The crystals are so sensitive to moisture that they cannot be preserved in a desiccator over concentrated sulfuric acid.



J. Boeseken, *Rec. trav. chim.*, **19**, 23 (1900)

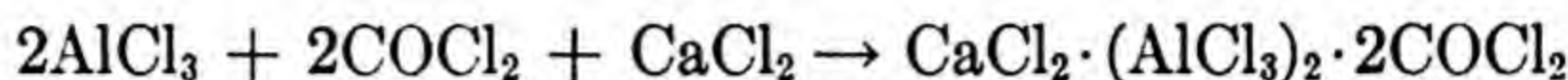
27



I-230



A carbonyl chloride solution of aluminum chloride reacts vigorously with calcium chloride producing a soluble double salt.



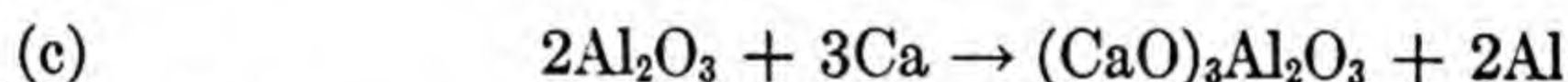
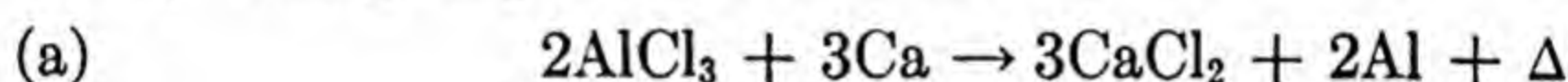
Germann and Gagos, *J. Phys. Chem.*, **28**, 965 (1924)

25



I-231

Aluminum chloride or oxide and metallic calcium react very readily, in fact violently, upon ignition with a fuse. With excess aluminum a readily fusing slag $\text{Al}_2\text{O}_3 \cdot 3\text{CaO}$ forms.



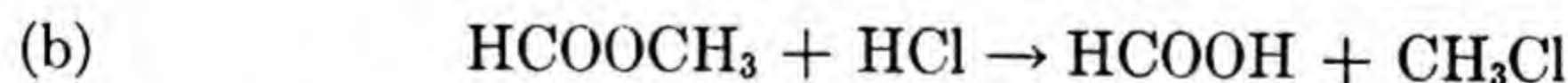
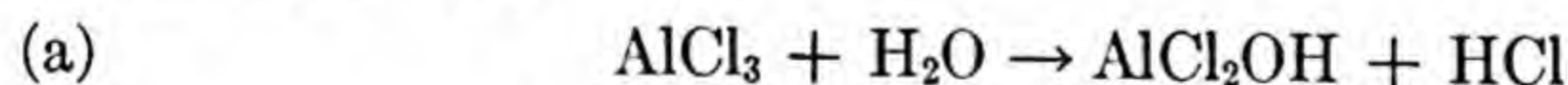
F. W. Perkin and L. Pratt, *Trans. Far. Soc.*, **3**, 181, 184 (1907)

85



I-232

When freshly prepared aluminum chloride crystals are dissolved in water containing methyl formate, the product of hydrolysis of the aluminum chloride hydrolyzes the ester. The hydrolysis of the salt proceeds chiefly to the first step only, little if any being hydrolyzed to the second step.



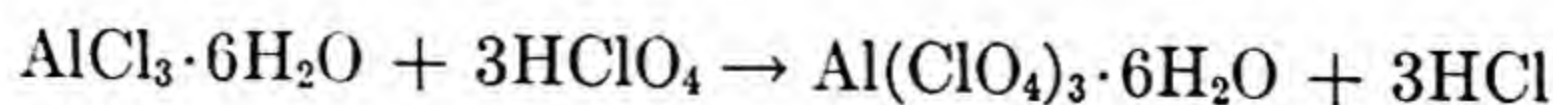
J. K. Wood, *J. Chem. Soc.*, (London), **93**, 417 (1908)

57



I-233

Hexahydrated aluminum perchlorate is made when hexahydrated aluminum chloride is dissolved in 20% perchloric acid and the solution heated on the water bath until all of the hydrogen chloride has been evolved.

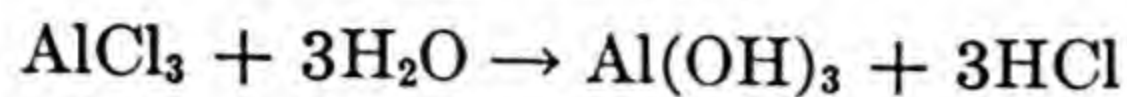


Weinland and Ensgraber, *Z. anorg. Chem.*, **84**, 370 (1914)

25

H₂O**AlCl₃****I-234**

Aluminum chloride hydrolyzes when treated with water giving aluminum hydroxide and hydrochloric acid.

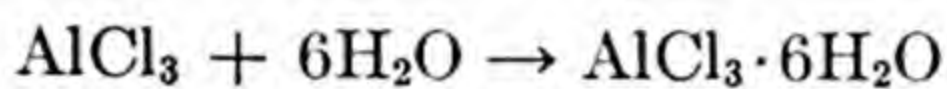


C. Kullgrew, Sv. Kem. Tidsk., **13**, 112 (1901)

10

H₂O**AlCl₃****I-235**

Aluminum can be separated from iron, titanium, the rare earths, gallium, and beryllium, by passing gaseous HCl into a concentrated solution of the salts in a mixture of HCl and ether. The solubility of AlCl₃ in the HCl-ether mixture is 5:125,000.



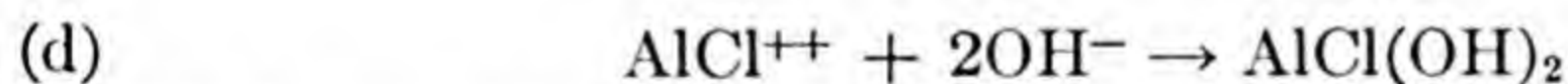
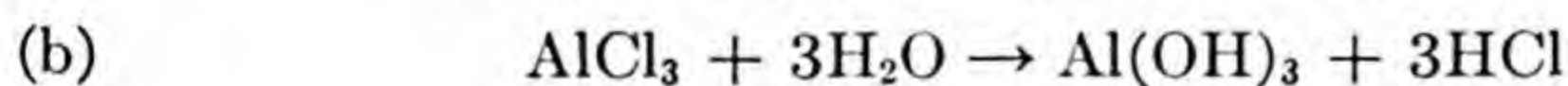
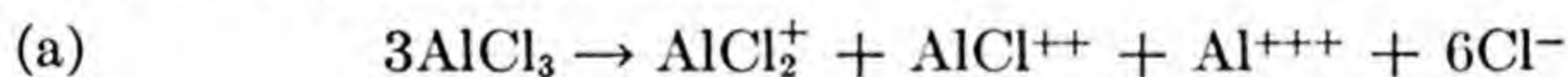
Gooch and Havens, Am. J. Sci. (4), **2**, 416, (1896)

Ref., Hillebrand and Lundell, Applied Inorganic Analysis, p. 392

93

H₂O**AlCl₃****I-236**

Aluminum chloride is a quaternary strong electrolyte, exerting a four-fold osmotic pressure in dilute solutions, corresponding to the four ions which are formed. Hydrolysis of the cations does not exceed 3.8% even in very dilute solutions.

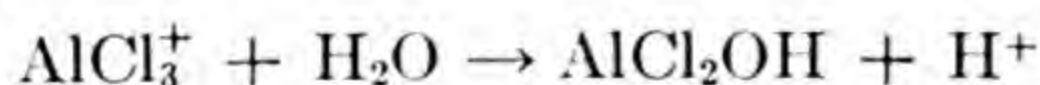


Jaroslav Heyrovský, J. Chem. Soc., **117:1**, 11 & 20 (1920)

48

H₂O**AlCl₃****I-237**

Aluminum chloride is hydrolyzed to the extent of from 2.80 to 7.93% at 25° in solutions of molar volume 16 to 128. E.m.f. measurements and equilibrium constant calculations show that the following represents the reaction:

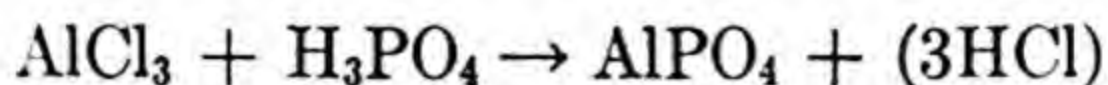


H. G. Denham, J. Chem. Soc., (London), **93**, 56 (1908)

57

H₃PO₄ **AlCl₃** **I-238**

Aluminum phosphate is obtained as a crystalline powder when aluminum chloride and phosphoric acid are heated together to 200°C.



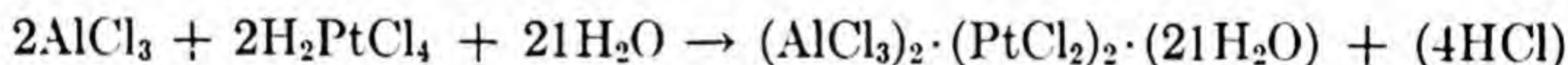
A. Schulten, *Compt. rend.*, **98**, 1583

Ref. Ber., **17**, 408 (1884)

25

H₂PtCl₄ **AlCl₃** **I-239**

Solutions of chloroplatinous acid and aluminum chloride, when mixed and evaporated, yield large, red, deliquescent, oblique, four-sided prisms of hydrated aluminum chloroplatinite. Similar method gives the corresponding salts of the trivalent metals Cr, Y, Er, La, Nd, and Ce, all of them hydrated and most of them red.

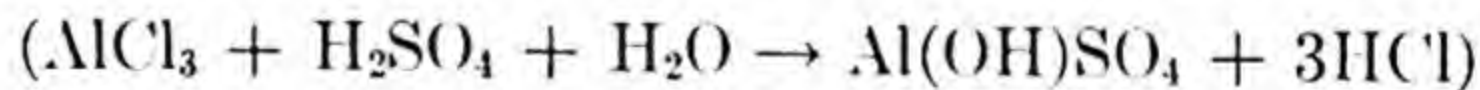


L. F. Nilson, *K. Sv. Vet. Akad. Handl, Öfvers*, **33**, 7, 16-17 (1876)

10

H₂SO₄ **AlCl₃** **I-240**

Aluminum can be quantitatively precipitated from the chloride solution at a pH of 6.5 to 7.5 by adding urea, ammonium chloride, ammonium sulfate and water in the ratios 4:20:1:500 respectively. The solution is heated till precipitation is complete. The precipitate is washed with 1% NH₄Cl, ignited at 1200°C yielding Al₂O₃.

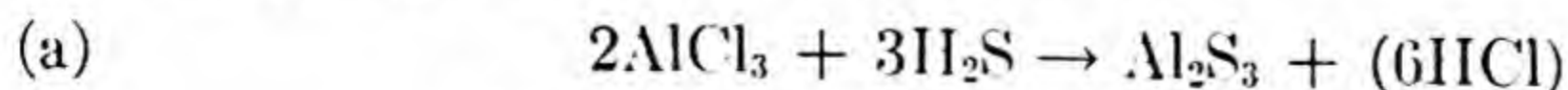


H. H. Willard and N. K. Tank, *Ind. and Eng. Chem., Anal. Ed.*, **9**, 357 (1937)

114

H₂SeO₃ **AlCl₃** **I-241**
H₂S

When aqueous solution of aluminum chloride is saturated with hydrogen sulfide, the sulfide will react with selenious acid solution yielding a yellow precipitate of selenium sulfide.

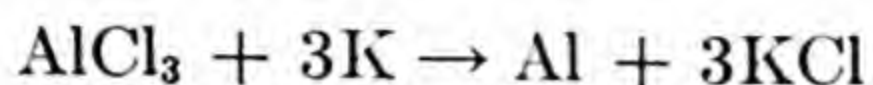


B. W. Nordlander, *Ind. Eng. Chem.*, **19**, 518 (1927)

24

**K****I-242**

Metallic potassium reduces aluminum chloride to aluminum when the two are heated together.



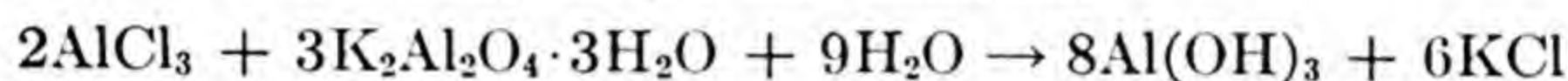
L. Wöhler, Pogg. Ann., **11**, 146

Ref., Ann., **92**, 252 (1854)

25

**K₂Al₂O₄****I-243**

To form a floc for water purification, aluminum chloride is treated with some aluminate yielding anhydrous alumina.

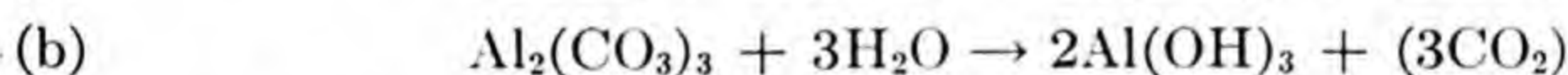
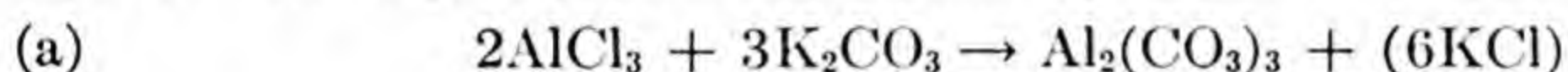


Mobert and Partridge, Ind. Eng. Chem., **22**, 163 (1930)

24

**K₂CO₃****I-244**

A solution of potassium carbonate was added to a solution of aluminum chloride and it precipitated aluminum hydroxide.

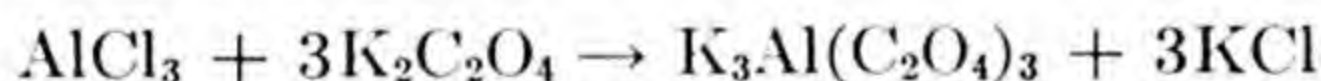


Charles Hatchett, Trans. Roy. Soc. (London), **88**, 117 (1898)

105

**K₂C₂O₄****I-245**

A solution of aluminum chloride is neutralized by potassium oxalate.



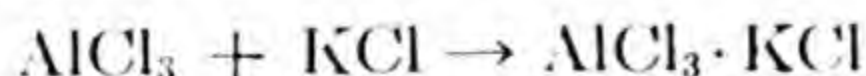
Feigl and Krauss, Ber., **58B**, 398 (1925)

Ref., Thomas and Tai, J. Am. Chem. Soc., **54**, 852 (1932)

1

**KCl****I-246**

Aluminum chloride in solution with potassium chloride forms the compound aluminum potassium chloride.

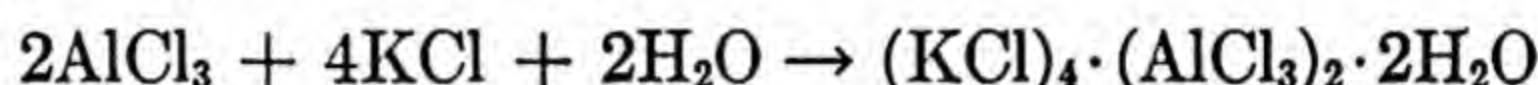


M. E. Band, Ann. Chim. phys. (8), **1**, 46 (1904)

100

**KCl****I-247**

Aluminum potassium chloride is formed by boiling a solution of aluminum chloride in fuming hydrochloric acid with potassium chloride in a stream of hydrogen chloride.

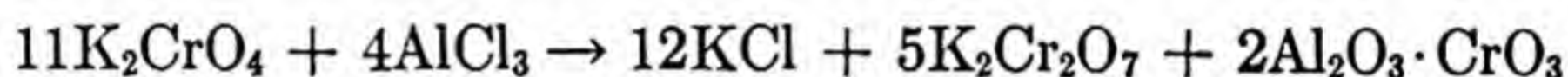


G. Neumann, *Ann.*, **244**, 329 (1888)

25

**K₂CrO₄****I-248**

A solution of aluminum chloride (48.3 g. per liter) reacts with a solution of potassium chromate.

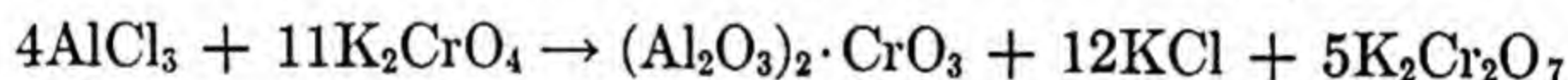


Groger, *Ber.*, **35**, 3420 (1902)

1

**K₂CrO₄****I-249**

When two moles of aluminum chloride are added to six moles of potassium chromate, complete precipitation of aluminum is obtained, but if less than six moles are added the precipitation is incomplete.

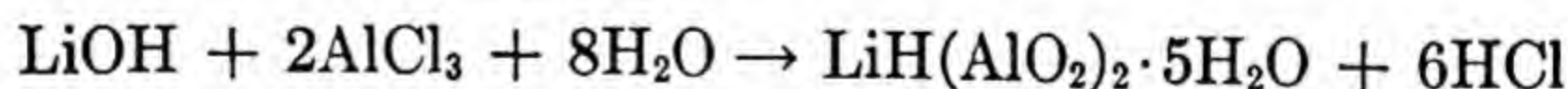


Max Gröger, *Ber.*, **35**, 3422 (1902)

25

**LiOH****I-250**

Lithium hydrogen aluminate is formed when lithium hydroxide solution is added to solutions of aluminum salts.



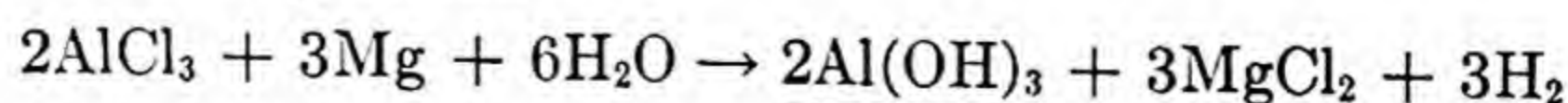
Dobbins and Sanders, *J. Am. Chem. Soc.*, **54**, 178 (1932)

Ref., J. Hegrousky, *J. Chem. Soc.*, **118**, 1013 (1920)

1

**Mg****I-251**

Aluminum hydroxide precipitates when a neutral water solution of aluminum chloride is digested for several hours on the water bath with metallic magnesium.



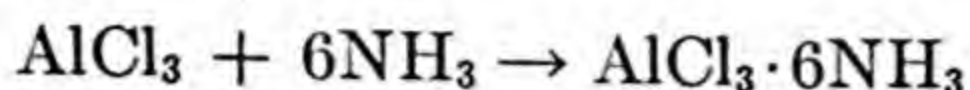
Seubert and Schmidt, *Ann.*, **267**, 232 (1892)

1


 NH_3

I-252

Aluminum chloride hexammoniate is formed when anhydrous aluminum chloride is treated with an excess of dry ammonia at ordinary temperature.



Baud, Compt. rend., **132**, 134 (1901)

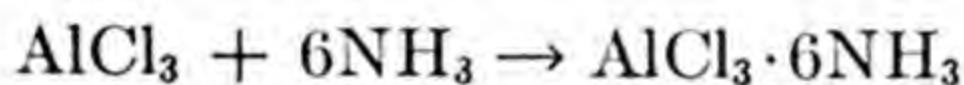
Ref., J. Chem. Soc., (London), **80**, 161 (1901)

25


 NH_3

I-253

Resublimed aluminum chloride was subjected to the action of ammonia gas, dried with potassium for a period of 12 hours, yielding aluminum chloride hexammoniate.



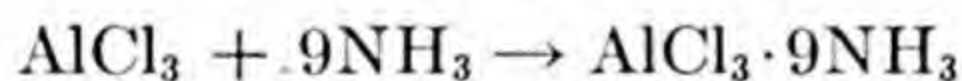
M. E. Band, Ann. Chim. phys. [8], **1**, 11 (1904)

100


 NH_3

I-254

Aluminum chloride treated with liquid ammonia forms aluminum chloride nonammoniate. The excess liquid ammonia is removed by passing a current of dry air over the remaining liquid.



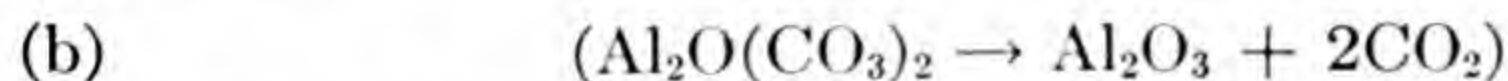
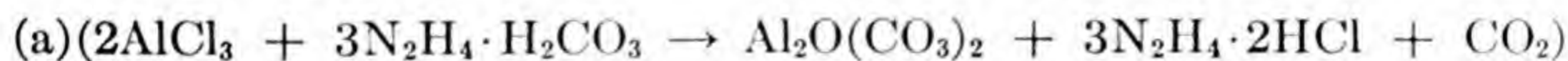
M. E. Band, Ann. Chim. phys. [8], **1**, 14 (1904)

100


 $\text{N}_2\text{H}_4 \cdot \text{H}_2\text{CO}_3$

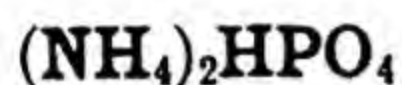
I-255

Solutions of aluminum salts are quantitatively precipitated by means of hydrazine carbonate in the form of a basic aluminum carbonate, (a), which upon ignition yields aluminum oxide, (b).



A. Jílek and J. Lukas, Chem. List., **24**, 365 (1930)

5



I-256

A double phosphate of aluminum and ammonium forms when a hot solution of diammonium phosphate is added to an acid solution of aluminum chloride.



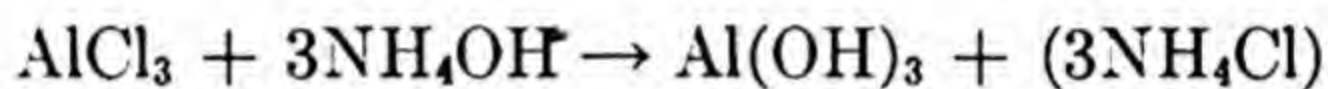
L. J. Cohen, J. Am. Chem. Soc., **29**, 720 (1907)

1



I-257

Ammonia precipitates aluminum hydroxide from a solution of aluminum chloride.



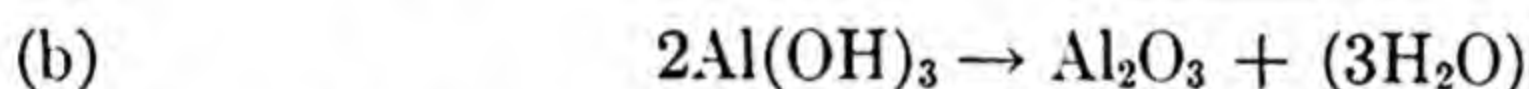
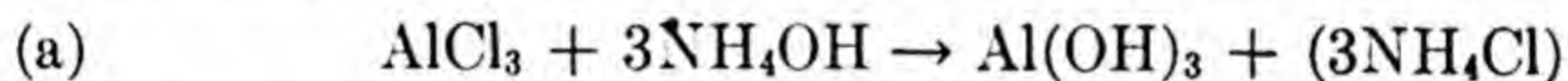
Charles Hatchett, Trans. Roy. Soc. (London), **88**, 575 (1898)

105



I-258

Aluminum oxide is prepared by heating the hydroxide which precipitates when aluminum chloride is treated with ammonium hydroxide.



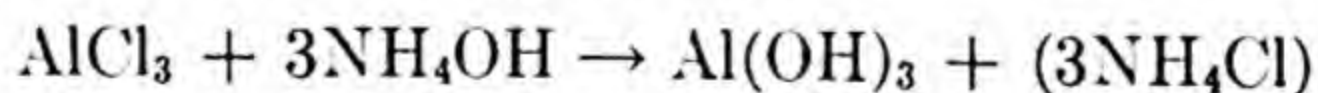
Poggendorff and Liebig Ann., **17**, 50 (1836)

25



I-259

Ammonium hydroxide was added to a solution of aluminum chloride, thus precipitating aluminum hydroxide.



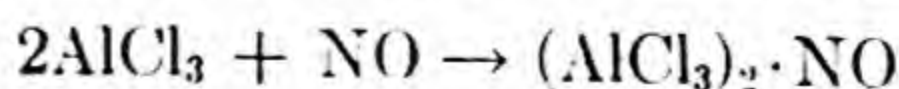
Richard Chenevix, Trans. Roy. Soc. (London), **92**, 331 (1902)

105



I-260

A pale yellow double compound is obtained when aluminum chloride reacts with nitric oxide when heated (in an atmosphere of an inert gas).



Thomas, Compt. rend., **121**, 128

Ref., Ber., **28**, 728 (1895)

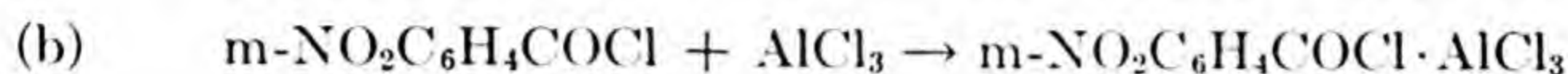
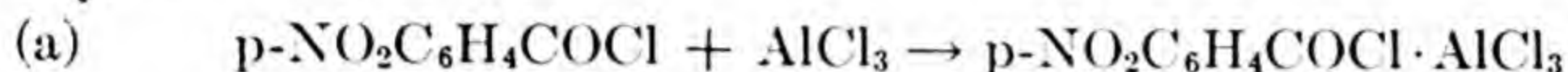
25



I-261



When aluminum chloride is added to a solution of para-nitrobenzoyl chloride in pure dry carbon bisulfide an addition product is formed which crystallizes in the absence of moisture. The crystals are so sensitive to moisture that they cannot be preserved in a desiccator over concentrated sulfuric acid. The same reaction takes place with the meta-nitrobenzoyl chloride.



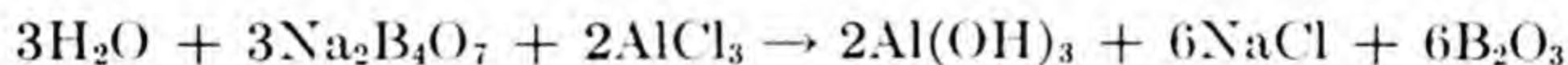
J. Boeseken, *Rec. trav. chim.*, **19**, 23 (1900)

27



I-262

Aluminum hydroxide precipitates when aluminum chloride is boiled with a solution of borax in presence of a solution of sodium carbonate.



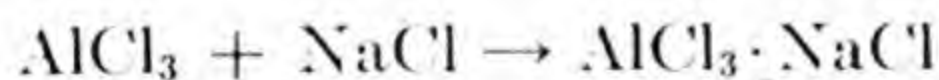
G. W. Sargent, *J. Am. Chem. Soc.*, **21**, 884 (1899)

1



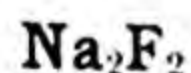
I-263

A solution of aluminum chloride mixed with a solution of sodium chloride forms aluminum sodium chloride.



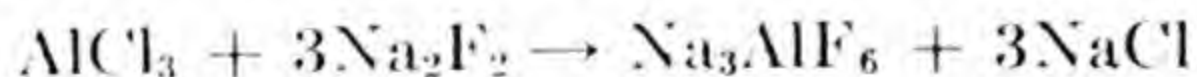
M. E. Band, *Ann. Chim. phys.* [8], **1**, 46, (1904)

100



I-264

Cryolite is precipitated when a solution of sodium fluoride is treated with a solution of aluminum chloride.



C. Pieper, D.R.P. 35212

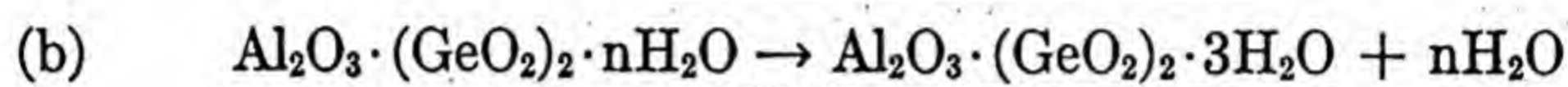
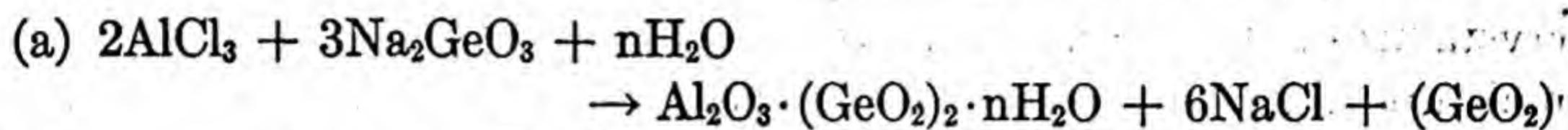
Ref., *Ber.*, **19**, 325 (1886)

25

AlCl_3 Na_2GeO_3

I-265

A solution of aluminum chloride will react with a solution of sodium germanate yielding hydrated aluminum germanate. When heated at a temperature of 100° trihydrated aluminum germanate is formed.



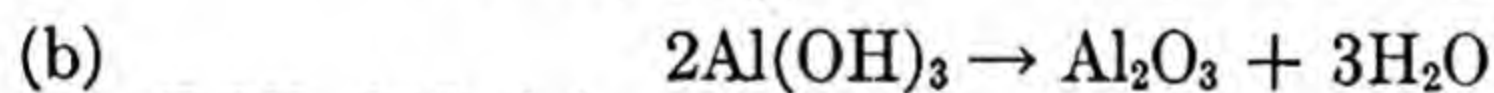
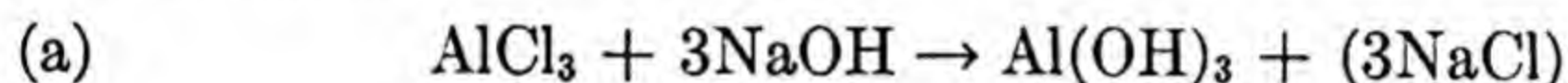
R. Schwarz and G. Trageser, *Z. Anorg. Chem.*, **208**, 65 (1932)

28

 AlCl_3 NaOH

I-266

Amorphous alumina gel (Al_2O_3) can be prepared by precipitating a solution of aluminum chloride with sodium hydroxide in the presence of phenol red as an indicator.



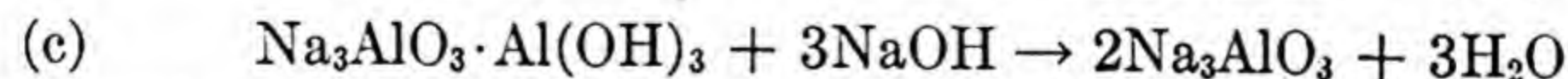
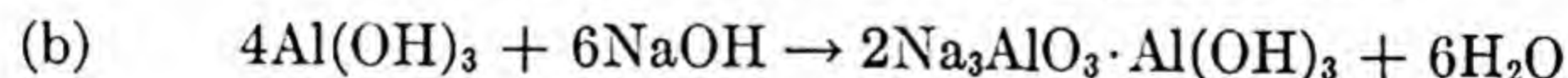
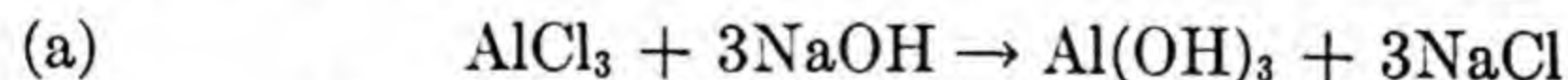
Insley and Ewell, *B. S. J. Res.*, **14**, 621 (1935)

93

 AlCl_3 NaOH

I-267

The addition of increasing quantities of sodium hydroxide to dilute solutions of aluminum chloride, sulfate or of potassium alum gives, in succession, the hydrate, a basic aluminate and an aluminate.



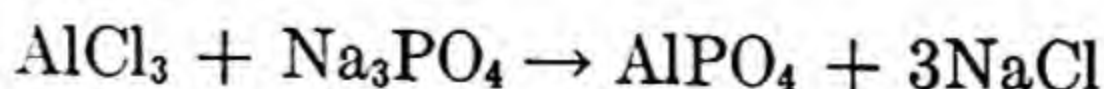
E. Grobet, *J. Chim. phys.*, **19**, 331 (1921)

69

 AlCl_3 Na_3PO_4

I-268

Aluminum phosphate is formed when aluminum chloride solution is treated with sodium phosphate.



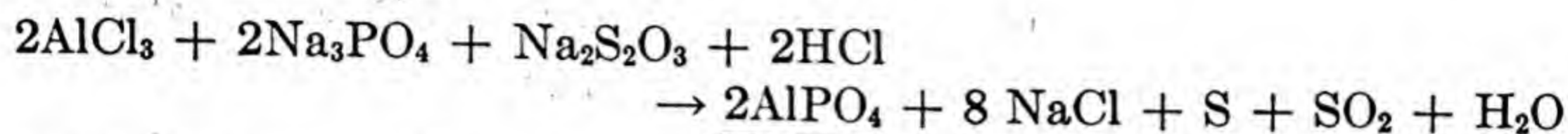
H. Bhattacharyya, *Chem. News*, **109**, 38 (1914)

25



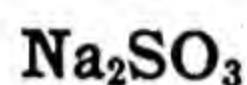
I-269

A solution containing aluminum chloride, hydrochloric acid and sodium phosphate yields aluminum phosphate when boiled with an excess of sodium thiosulfate.



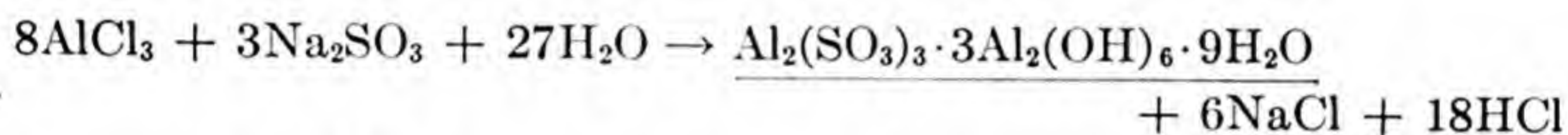
H. Bhattacharyya, Chem. News, **109**, 38 (1914)

25



I-270

A white precipitate of basic aluminum sulfite is formed when a diluted solution of aluminum chloride reacts with a diluted solution of sodium sulfite.



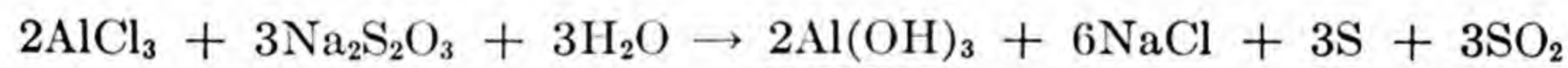
K. Seubert and M. Elten, Z. anorg. Chem., **4**, 44 (1893)

28



I-271

A neutral solution of aluminum chloride decomposes a solution of sodium thiosulfate with the precipitation of a mixture of aluminum hydroxide and sulfur.



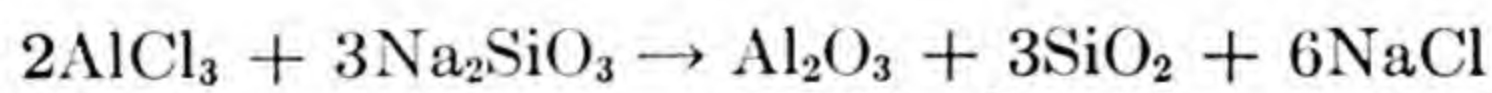
G. Vortmann, Ber., **22**, 2307 (1889)

25



I-272

Aluminum oxide and silicon dioxide are formed when solutions containing molar quantities of sodium silicate and aluminum chloride react at 20°:



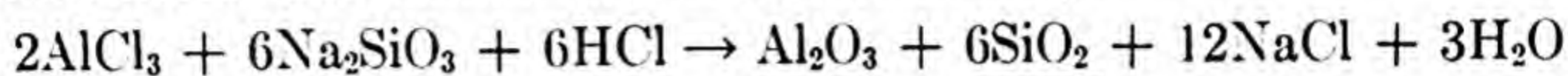
Schwarz and Brenner, Ber., **56**, 1433 (1923)

25

AlCl₃Na₂SiO₃ + HCl

I-273

Aluminium oxide and silicon dioxide are formed when the calculated amount of hydrochloric acid is allowed to react with solutions of aluminium chloride and sodium silicate simultaneously.



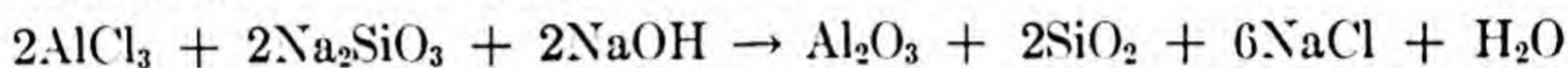
Schwarz and Waleker, *Z. Anorg. Chem.*, **145**, 306 (1925)

1

AlCl₃Na₂SiO₃ + NaOH

I-274

Aluminum oxide and silicon dioxide are formed when a corresponding amount of sodium hydroxide solution is allowed to react with aluminum chloride and sodium silicate in solution.



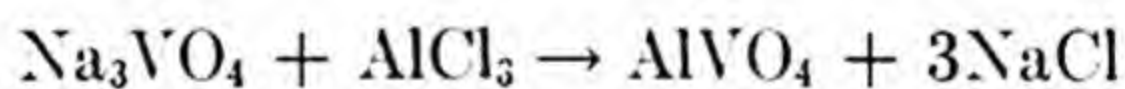
Schwarz and Brenner, *Ber.*, **56**, 1433 (1923)

25

AlCl₃Na₃VO₄

I-275

Sodium orthovanadate, when added to any soluble aluminum salt, precipitates yellow gelatinous aluminum vanadate soluble in excess of either reagent.



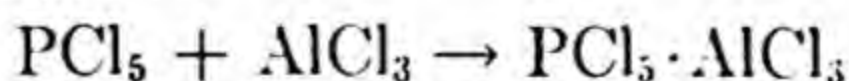
H. E. Roscoe, *Trans. Roy. Soc. (London)*, **160**, 324 (1870)

105

AlCl₃PCl₅

I-276

Phosphorus pentachloride unites with aluminum chloride to form aluminum chlorophosphate.



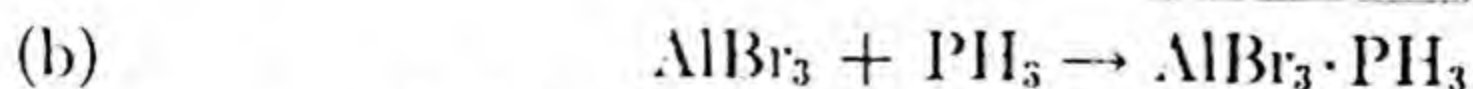
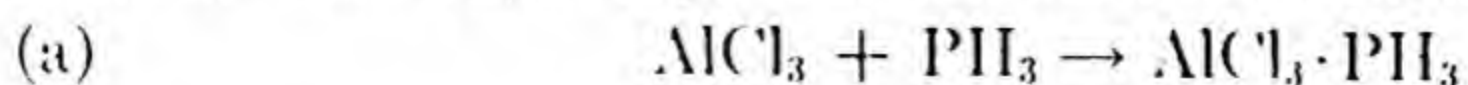
E. Baudrimont, *Compt. Rend.*, **55**, 363 (1862)

29

AlCl₃PH₃

I-277

By heating aluminum chloride with phosphine at a temperature of 50–70° white colored crystals of monophosphine-aluminum chloride are formed. The same type reaction occurs with aluminum bromide.



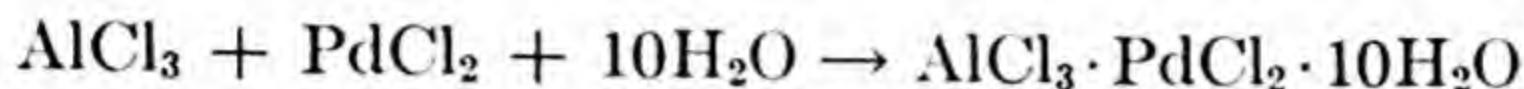
R. Hölftje and F. Meyer, *Z. anorg. Chem.*, **197**, 93 (1931)

28



PdCl₂ **I-278**

Palladous chloride, when added to a hydrochloric acid solution of aluminium chloride, on evaporation over sulfuric acid yields a double salt.



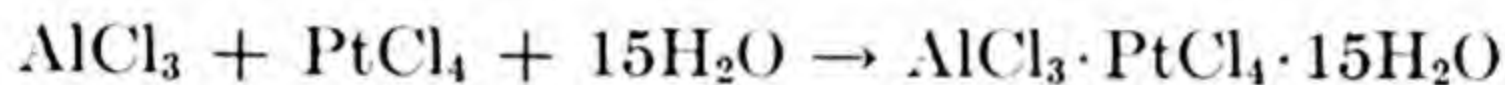
A. Welkow, Ber., 7, 802 (1874)

11



PtCl₄ **I-279**

A concentrated solution of aluminum and platinic chlorides yields large orange crystals of a double salt.



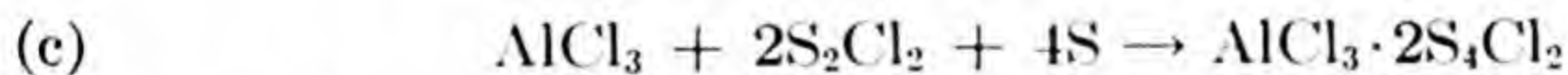
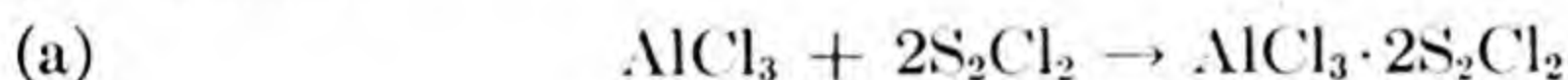
A. Welkow, Ber., 7, 304 (1874)

11



S₂Cl₂ **I-280**
S

A mixture of aluminum chloride, sulfur monochloride and sulfur is heated to boiling in a sealed tube. The liquid obtained is composed of two layers. In the lower layer three complex aluminum compounds are formed.



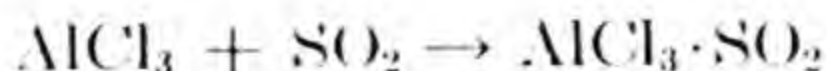
O. Ruff and H. Golla, Z. anorg. Chem., **138**, 17 (1924)

28



SO₂ **I-281**

Aluminum chloride treated with liquid sulfur dioxide forms a compound of aluminum chloride with sulfur dioxide.



M. E. Band, Ann. chim. phys. [8], **1**, 33 (1904)

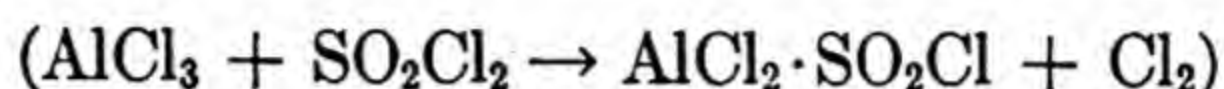
100

AlCl₃SO₂Cl₂

I-282

Add recently sublimed and finely ground aluminum chloride (15 gr.) to sulfuryl chloride (30 cc.) and agitate the mixture until solution is complete, at the same time raising the temperature from 0 to 30°. After filtering, a solution of aluminum sulfurylchloride is obtained.

This solution fumes strongly in the air and is decomposed by water.



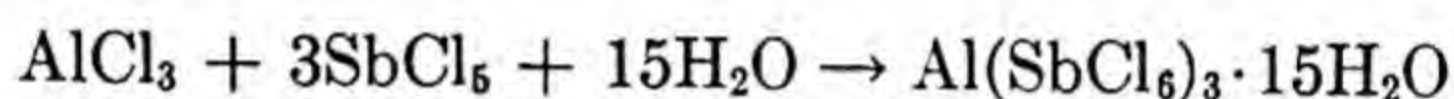
Oswald Silberrad, J. Chem. Soc., **121**, 1017 (1922)

48

AlCl₃SbCl₅

I-283

Yellowish green, hygroscopic crystalline needles of aluminum meta-chloroantimonate are formed from a solution containing molecular quantities of aluminum chloride and antimony pentachloride.



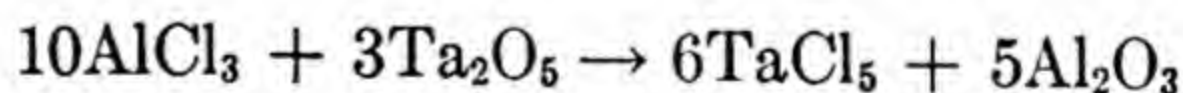
Weinland and Feige, Ber., **36**, 244 (1903)

25

AlCl₃Ta₂O₅

I-284

Tantalum pentachloride is obtained by heating tantalum pentoxide with aluminum chloride.



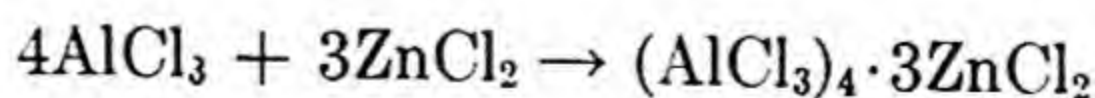
Ruff and Thomas, Ber., **55**, 1466 (1922)

25

AlCl₃ZnCl₂

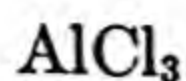
I-285

Aluminum chloride forms a double salt with zinc chloride which is aluminum zinc chloride.



M. E. Band, Ann. chim. phys. [VIII], **1**, 56 (1904)

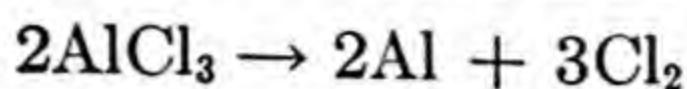
100



€

I-286

Aluminum is formed when molten aluminum chloride is electrolyzed.



R. Bunsen, *Ann.*, **82**, 137 (1852)

Ref., *Ann.*, **92**, 252 (1854)

25



€

I-287

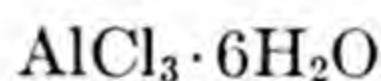
Δ

The band spectrum of aluminum chloride shows the presence of the diatomic molecules AlCl^{35} and AlCl^{37} . The discharge has a pale blue color. The discharge tube is operated from a Feranti transformer with the primary at 80 volts and 3 amperes.



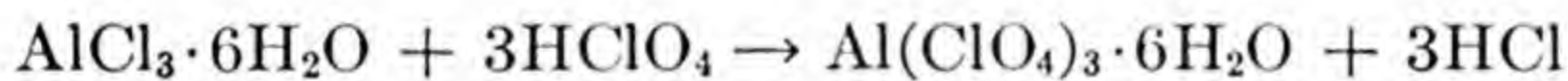
B. N. Bhaduri, *Proc. Roy. Soc. (London)*, **145A**, 321 (1934)

110

 HClO_4

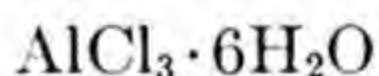
I-288

A solution of aluminum chloride hexahydrate in 20% perchloric acid is heated on the water bath. Colorless crystals of complex aluminum compound are obtained by keeping the solution in vacuo over concentrated sulfuric acid.



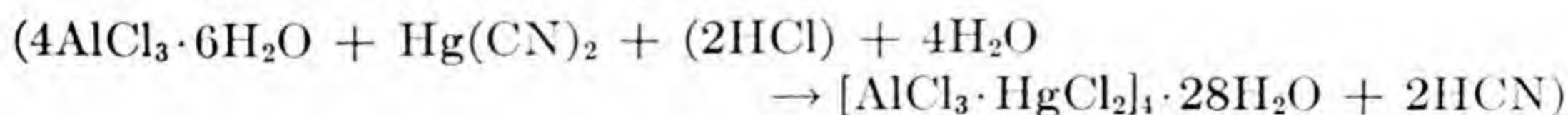
R. F. Weinland and Fr. Ensgraber, *Z. anorg. Chem.*, **84**, 368 (1914)

28

 $\text{Hg}(\text{CN})_2$

I-289

About 25 grams of hydrated aluminum chloride are dissolved in 100 cc. of water, and a cold solution of 10 grams of mercuric cyanide in 100 cc. of water is added. If the mixture be evaporated to 50 cc. and kept over sulfuric acid in vacuo for several days, a crystalline crust of the double salt of aluminum chloride and mercuric chloride is formed. Strong odor of hydrocyanic acid is given off.

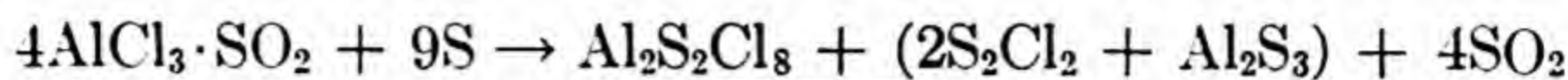


Lilananda Gupta, *J. Chem. Soc. (London)*, **117** 72 (1920)

48

AlCl₃SO₂**S****I-290**

Aluminum sulfur chloride separates when a solution of aluminum chlor-sulfoxide is treated with finely powdered sulfur.

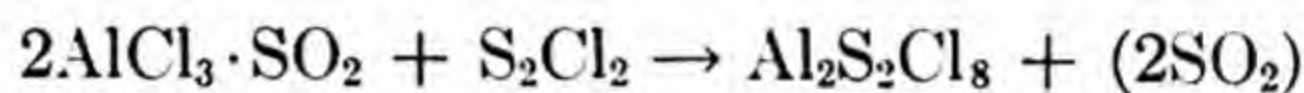


Oswald Silberrad, J. Chem. Soc. (London), **121**, 1017 (1922)

25

AlCl₃SO₂**S₂Cl₂****I-291**

Aluminum sulfur chloride is formed when sulfur monochloride is added to a solution of aluminum chlor-sulfoxide.

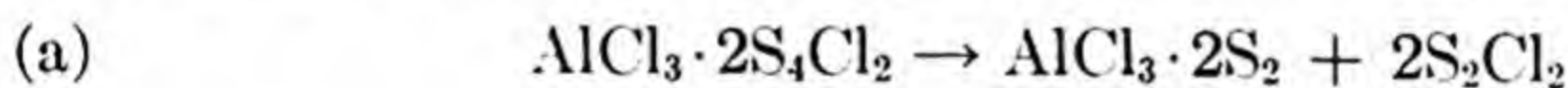


Oswald Silberrad, J. Chem. Soc. (London), **121**, 1017 (1922)

25

AlCl₃·2S₄Cl₂**(CS₂)****I-292**

By extracting with carbon disulfide the complex aluminum compound obtained in course of the reaction of aluminum chloride with sulfur monochloride and sulfur, two complex aluminum compounds are obtained.

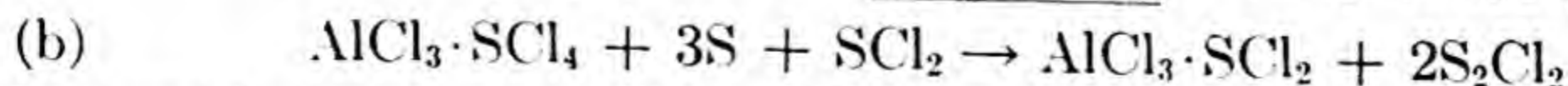
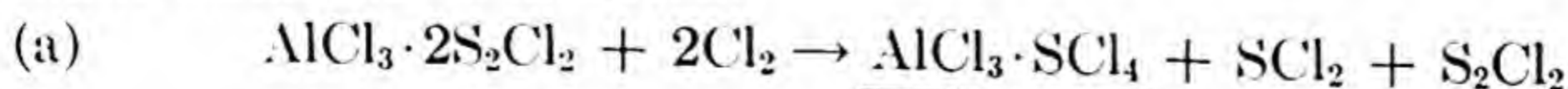


O. Ruff and H. Golla, Z. anorg. Chem., **138**, 17 (1924)

28

AlCl₃·2S₂Cl₂**Cl****I-293****S**

The complex aluminum compound obtained by the reaction of aluminum chloride with sulfur monochloride will react with chlorine yielding a complex compound in form of yellow crystals. When this compound reacts with sulfur a new, until now unknown, aluminum compound with sulfur dichloride is obtained.



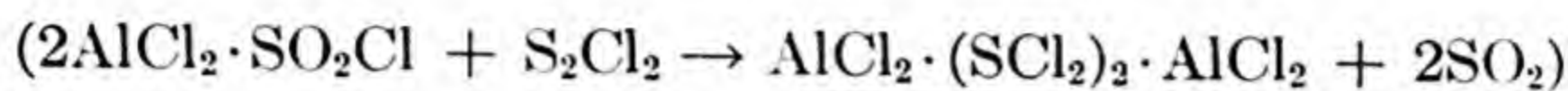
Ruff and Golla, Z. anorg. Chem., **138**, 17 (1924)

28

 S_2Cl_2

I-294

When sulfur monochloride (or finely ground sulfur) is added to a solution of aluminum sulfuryl chloride, a solid mass of aluminum sulfur chloride precipitates. The compound can be obtained in crystalline form if the reagents are dissolved in thionyl chloride and sulfuryl chloride respectively.



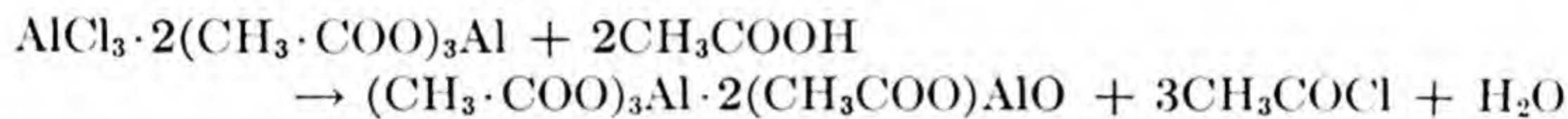
Oswald Silberrad, J. Chem. Soc., **121**, 1017 (1922)

48

 CH_3COOH

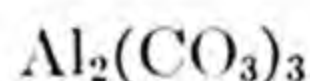
I-295

The complex aluminum chloride-aluminum acetate obtained by the reaction of aluminum chloride with acetic acid, is heated with acetic acid (100%). The crystals will dissolve. After cooling, crystals of a complex basic aluminum acetate are formed.



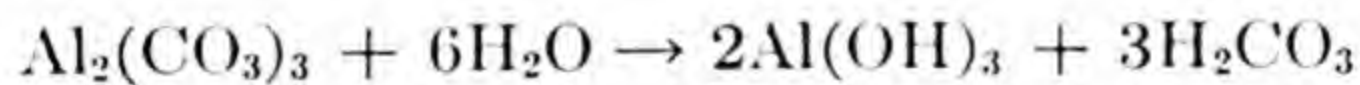
H. Funk and J. Schormüller, Z. anorg. Chem., **199**, 93 (1931)

28

 H_2O

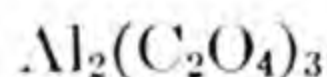
I-296

Freshly precipitated aluminum carbonate hydrolyzes in water giving carbonic acid and precipitated aluminum hydroxide.



C. Kullgren, Sv. Kem. Tidskr., **13**, 116 (1901)

10

 BaCl_2

I-297

A solution of aluminum oxalate will react with a solution of barium chloride yielding white crystals of the composition shown below.



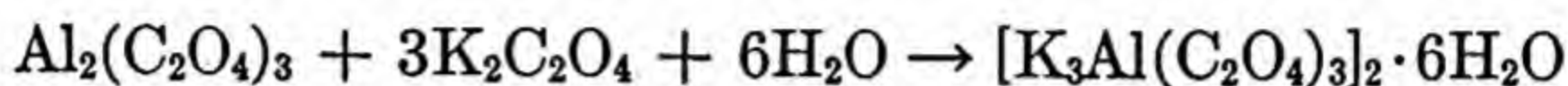
A. Rosenheim, Z. anorg. Chem., **11**, 175 (1896)

28



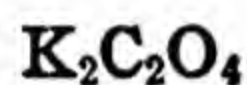
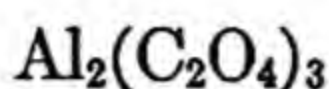
I-298

Potassium aluminum oxalate is obtained by the crystallization of a mixture of diluted solutions of aluminum oxalate and potassium oxalate.

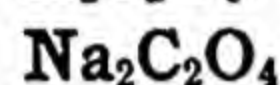


F. Kehrman and Nicolas Pickersgill, *Z. anorg. Chem.*, **4**, 133 (1893)

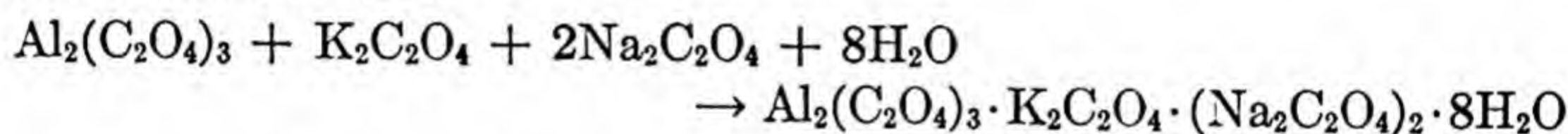
28



I-299

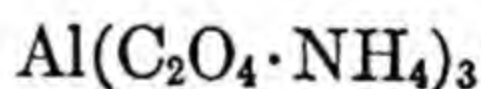


Aluminum-potassium-sodium oxalate is obtained by the crystallization of a mixture of diluted solutions of aluminum oxalate, potassium oxalate and sodium oxalate.



F. Kehrman and N. Pickersgill, *Z. anorg. Chem.*, **4**, 133 (1893)

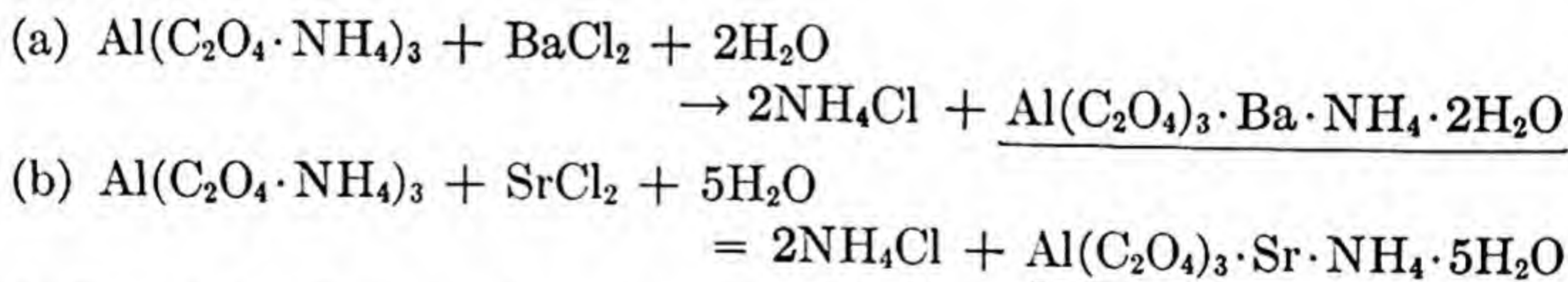
28



I-300

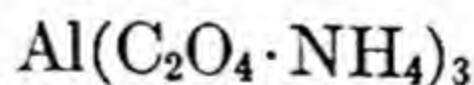


By adding small portions of barium chloride to a solution of aluminum ammonium oxalate, white needles of barium ammonium aluminum oxalate are obtained. The same type reaction occurs with strontium chloride.



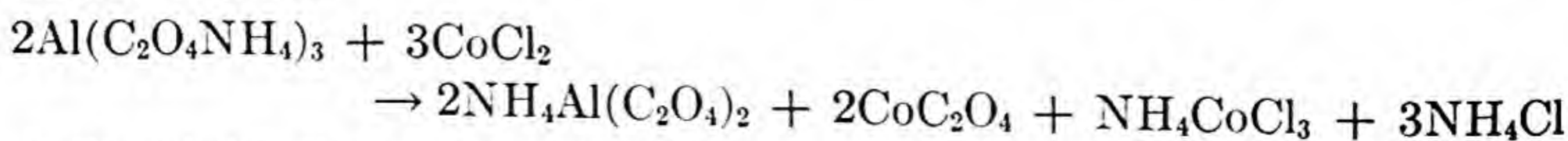
A. Rosenheim, *Z. anorg. Chem.*, **21**, 1 (1899)

28



I-301

A solution of aluminum ammonium oxalate will react with a solution of cobaltous chloride yielding colorless crystals of aluminum ammonium cobalt oxalate.



A. Rosenheim, *Z. anorg. Chem.*, **21**, 1 (1899)

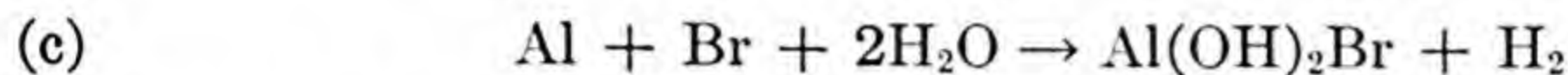
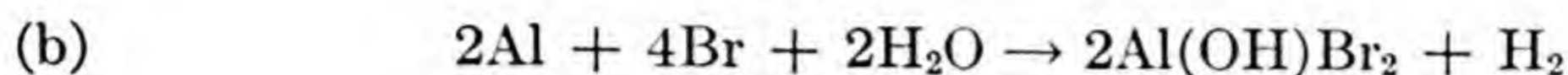
28

Al-Cu

Br

I-302

When an aluminum-copper alloy containing over 50% of aluminum is treated with a concentrated solution of bromine-potassium bromide in water, the principal reaction, (a), is accompanied by a secondary reaction, (b) or (c).



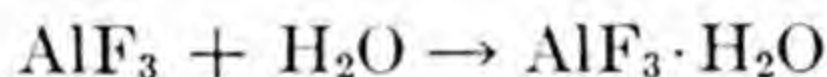
W. Louguinine and A. Schukareff, *J. Chim. phys.*, **1**, 9 (1903)

69

AlF₃H₂O

I-303

Aluminum fluoride treated with steam forms aluminum fluoride monohydrate.



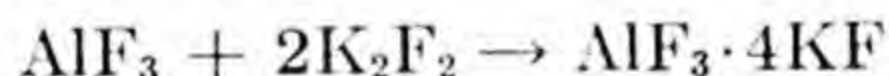
M. E. Band, *Ann. Chim. phys. [VIII]*, **1**, 63 (1904)

100

AlF₃K₂F₂

I-304

If potassium fluoride is added to a solution of aluminum fluoride, a difficultly soluble double salt is formed.



Dammer's *Anorg. Chem.*, III, 97

Ref., Cushman and Hubbard, *J. Am. Chem. Soc.*, **30**, 791 (1908)

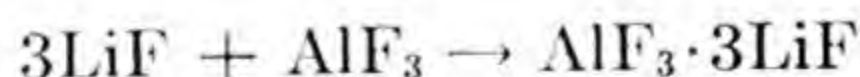
1

AlF₃

LiF

I-305

The binary system lithium fluoride-aluminum fluoride gives a definite double salt.

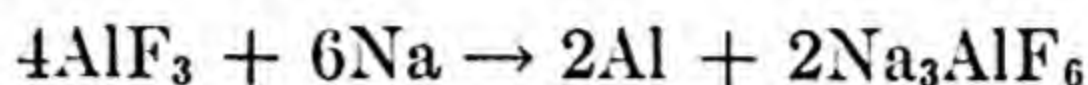


N. A. Preshin and A. V. Baskov, *J. Russ. Phys. Chem. Soc.*, **45**, 82

2

**Na****I-306**

Aluminum is obtained when aluminum fluoride reacts with sodium or any alkali metal.



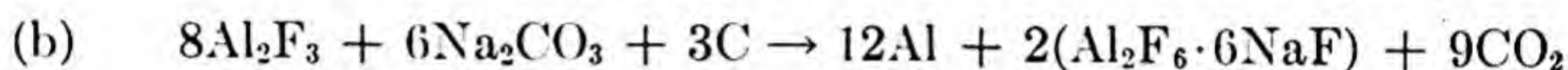
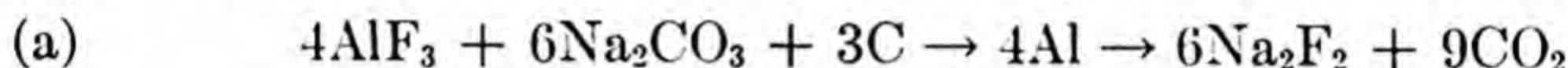
L. Grabau, D.R.P. 47031

Ref., Ber., **22**, 459 (1889)

25

**Na₂CO₃ + C****I-307**

Aluminum and sodium fluoride are obtained at the same time when a mixture of sodium carbonate and aluminum fluoride is electrolyzed using a carbon anode and an aluminum cathode.



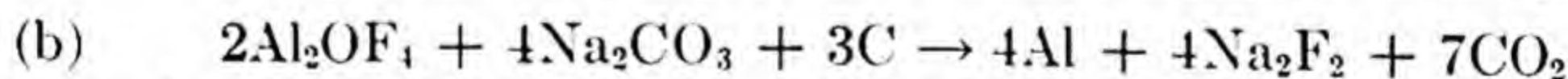
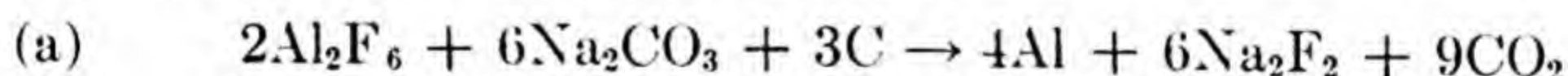
L. Grabau, D.R.P. 62851

Ref., Ber., **25**, 814 (1892)

25

**Na₂CO₃ + C****I-308**

By electrolyzing a solution containing a mixture of aluminum fluoride (a), or aluminum oxyfluoride (b), and sodium carbonate, dissolved in cryolite, metallic aluminum is deposited on the aluminum cathode. The carbon anode is oxidized to CO₂.



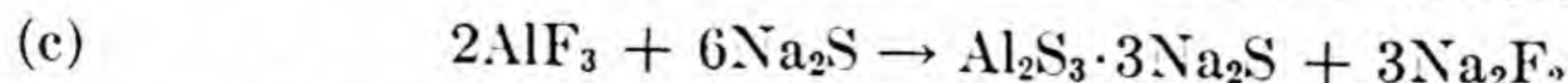
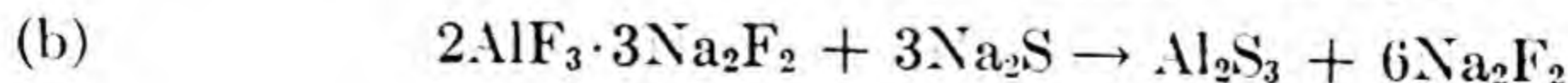
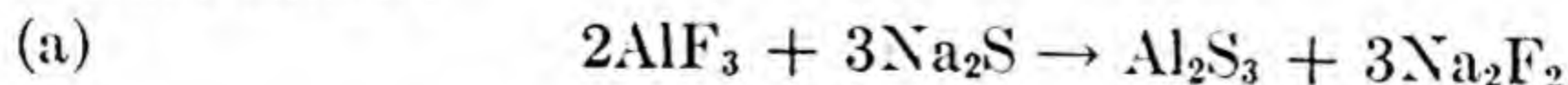
L. Grabau, D. R. P., 62, 851

Ref., Ber., **25**, 814 (1892) abstr.

25

**Na₂S****I-309**

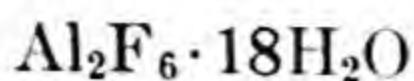
A double sulfide is formed by heating together aluminum fluoride and sodium sulfide.



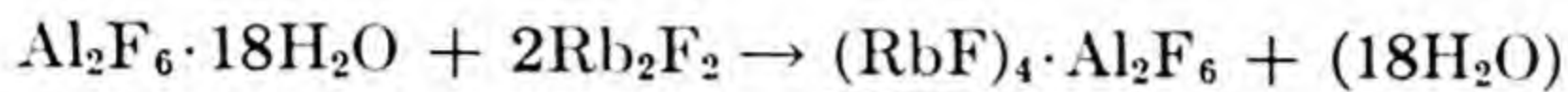
Peniakoff, D.R.P. 89143 (1895)

Ref., Ber., **29**, 1020 (1896)

25

**Rb₂F₂****I-310**

A double salt is formed when a molecular equivalent of aluminum fluoride is added to six molecular equivalents of rubidium fluoride and the resulting solution and precipitate are subjected to a temperature of 270°.



M. Tosterud, J. Am. Chem. Soc., **48**, 4 (1926)

1

**CCl₄****I-311**

A saturated solution of aluminum triiodide in carbon disulfide is treated with carbon tetrachloride, diluted with an equal volume of carbon disulfide, cooled to 0°. The mixture is washed with water and the carbon disulfide distilled off in the absence of air. The residue is treated with sodium sulfite solution to remove the iodine.



M. G. Gustavson, Ann. Chem. Pharm., **172**, 174 (1874)

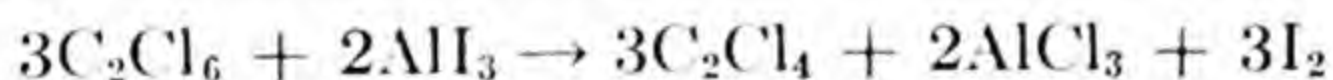
20

Gustavson, J. Prakt. Chim., (2), **63**, 110 (1901)

25

**C₂Cl₆****I-312**

Aluminum iodide reacts partially with hexachloroethane upon heating, according to the following reaction:



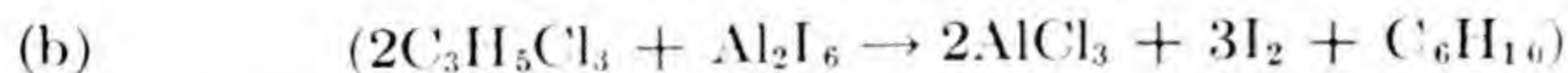
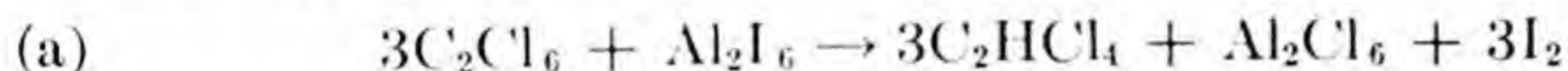
G. Gustavson,

Ref., F. Wreden, Ber., **9**, 1607, (1876)

26

**C₂Cl₆****I-313****C₃H₅Cl₃**

Aluminum triiodide reacts somewhat slowly on hexachloro ethane yielding tetrachloro ethylene (a), but the action is more vigorous on trichloro hydrin (b).



G. Gustavson,

Ref. F. Wreden, Ber., **9**, 1607 (1876)

25

AlI₃CH₃CCl₃

I-314

Methyl iodoform is produced when aluminum iodide reacts with methyl chloroform.



P. DeBoissieu, *Bull. Soc. Chim.*, **49**, 17

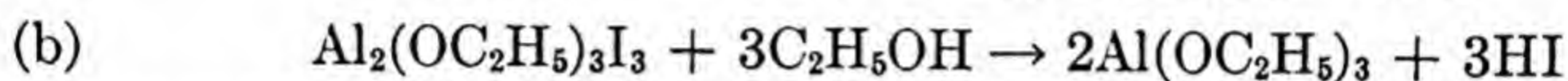
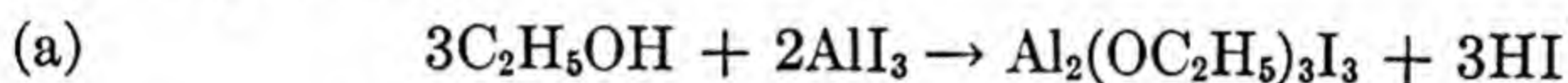
Ref., M. L., *J. Am. Chem. Soc.*, **10**, 114 (1888)

1

AlI₃C₂H₅OH

I-315

Aluminum ethylate is obtained when aluminum iodide is treated with ethyl alcohol.



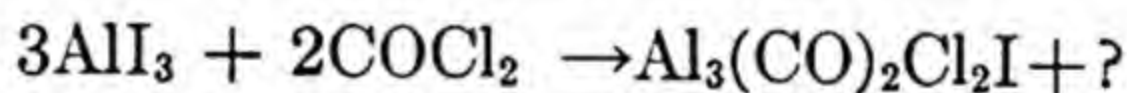
Hillyer and Crooker, *Am. Chem. J.*, **19**, 38 (1897)

1

AlI₃COCl₂

I-316

Aluminum iodide is heated to 200°. Then a stream of carbonyl chloride is passed through. An amorphous substance of brown color, aluminum carbonoxide chloroiodide, is obtained.



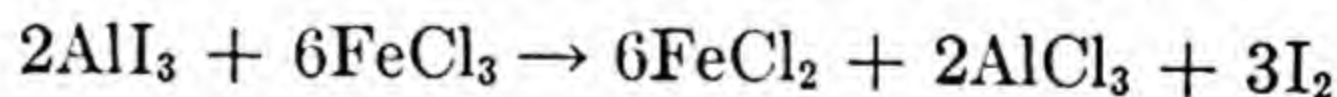
A. v. Bartal, *Z. anorg. Chem.*, **56**, 51 (1908)

28

AlI₃FeCl₃

I-317

Free iodine is formed when ferric chloride reacts with aluminum iodide.



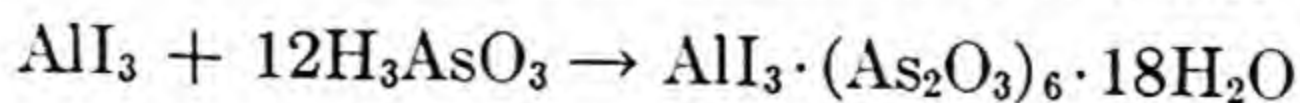
Seubert and Gaab, *Z. anorg. Chem.*, **9**, 212 (1895)

25

AlI₃H₃AsO₃

I-318

Small crystals separate when a moderately concentrated solution of aluminum iodide is saturated with arsenious acid under heating.



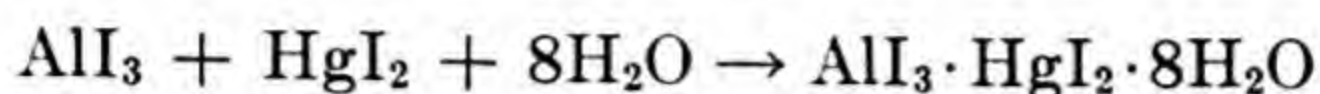
Weinland and Gruhl, *Arch. Pharm.*, **255**, 467 (1917)

Ref., *J. Chem. Soc.*, (London), **116**, 411 (1919)

25

**HgI₂****I-319**

When a solution of aluminum iodide and mercuric iodide, from which the "oxyiodide" initially formed has been removed, is allowed to stand for a period of time in a dry atmosphere, very long, highly hygroscopic crystals are deposited in small amounts.



A. Duboin, *Compt. rend.*, **146** 1028 (1908)

38

**KNH₂****I-320**

To a liquid ammonia solution of aluminum iodide is added potassium amide in insufficient amount to form a precipitate. The solution, on careful concentration, yields a crop of well formed crystals of the ammonobasic salt.



E. C. Franklin, *Proc. Nat. Acad.* **1**, 70 (1915)

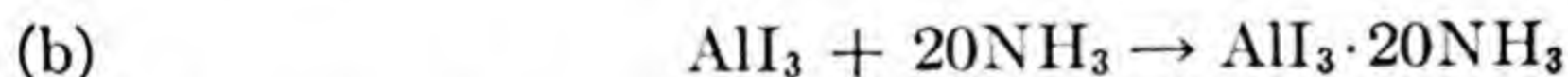
65

Ref., E. C. Franklin, *J. Am. Chem. Soc.*, **37**, 849 (1915)

1

**NH₃****I-321**

Aluminum iodide hexammoniate forms when aluminum iodide reacts with liquid ammonia. Excess NH₃ yields a higher ammoniate, (b).

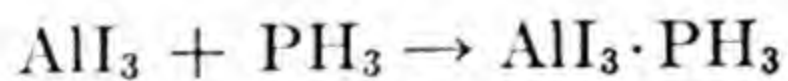


E. C. Franklin, *J. Am. Chem. Soc.*, **37**, 848 (1915)

1

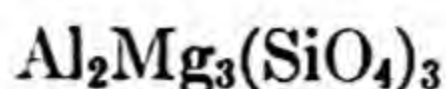
**PH₃****I-322**

By heating aluminum iodide with phosphine at a temperature of 50–70°, white colored crystals of monophosphine-aluminum iodide are formed.

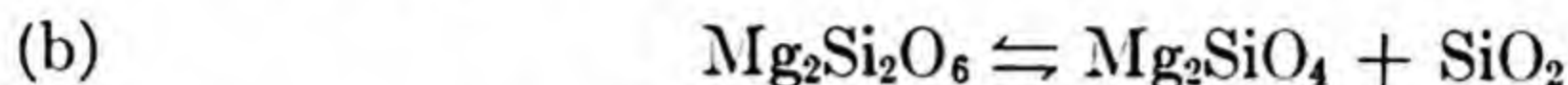


R. Hölftje and F. Meyer, *Z. anorg. Chem.*, **197**, 93 (1931)

28

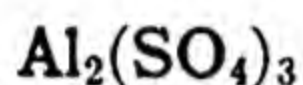
**Changing Δ & $\underline{\text{P}}$** **I-323**

The homogeneous equilibria involved in igneous magmas suffice to explain the various associations of these rocks. Some typical representations follow:

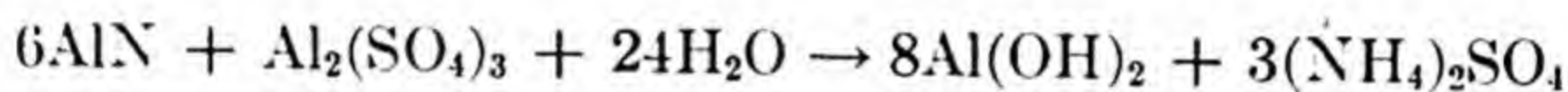


P. Niggli, Trans. Far. Soc., **20**, 428 (1923)

85

**I-324**

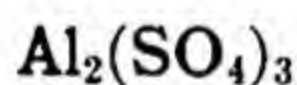
When aluminum nitride is heated with aluminum sulfate or sulfuric acid, and water, ammonium sulfate and aluminum hydroxide are formed.



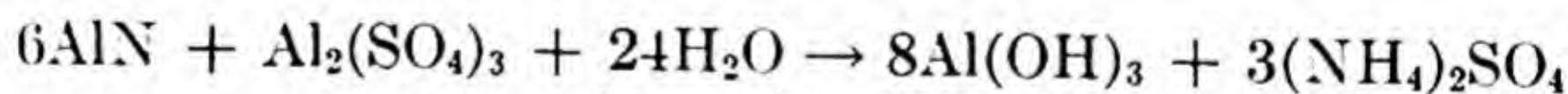
Badische Anilin and Soda Fabrik, D.R.P. 235868

Ref., J. Chem. Soc., (London), **100**, 1088 (1911)

1

**I-325**

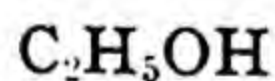
Aluminum hydroxide and ammonium sulfate are formed when aluminum nitride is boiled with aluminum sulfate.



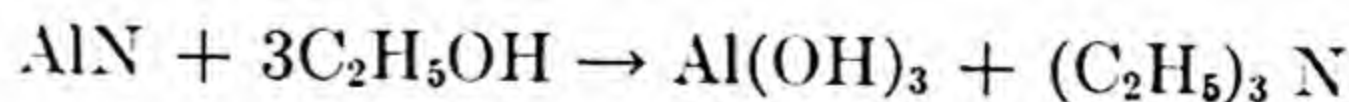
Badische-Anilin, Soda-Fabrik, D.R.P., 235,868

Ref., J. Chem. Soc., (London), **100**, 1088 (1911)

25

**I-326**

Aluminum hydroxide is formed when aluminum nitride is treated with ethyl alcohol at 230°C. in a sealed tube. Tertiary ethylamine is found in solution.



Fichter and Spengel, Z. anorg. Chem., **82**, 200 (1913)

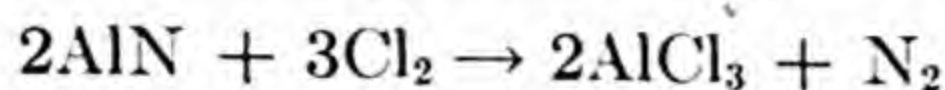
25

AlN

Cl₂

I-327

Aluminum chloride is obtained when aluminum nitride is heated in a chlorine gas atmosphere, (temperature 760°).



Fr. Fichter and A. Spengel, *Z. anorg. Chem.*, **82**, 192 (1913)

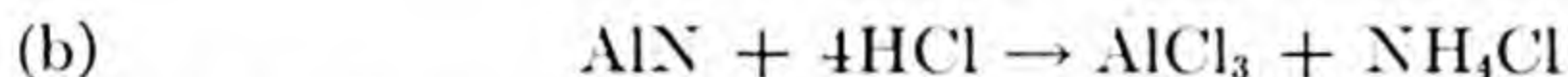
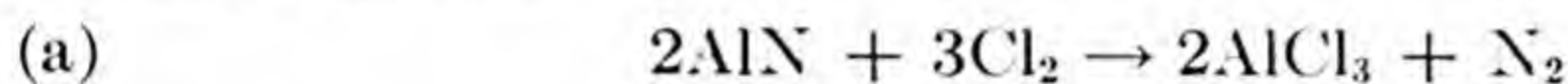
28

AlN

Cl₂

I-328

When aluminum nitride is treated with oxygen-free chlorine gas at about 760°C. a good yield of aluminum chloride is obtained (a). A larger yield is obtained when the nitride is treated with hydrogen chloride gas (b).



Fichter and Spengel, *Z. anorg. Chem.*, **82**, 198 (1913)

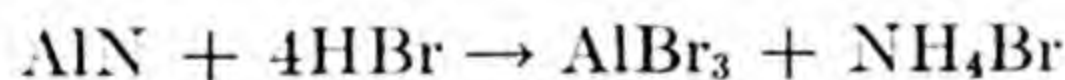
28

AlN

HBr

I-329

Aluminum bromide and ammonium bromide are formed when hydrobromic acid decomposes aluminum nitride.



Fichter and Spengel, *Z. anorg. Chem.*, **82**, 195 (1913)

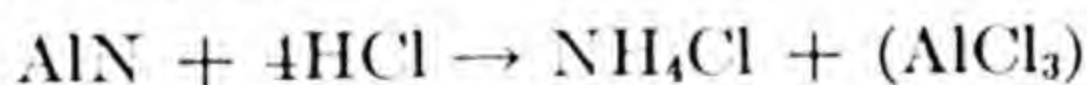
25

AlN

HCl

I-330

When aluminum containing nitrogen is treated with hydrochloric acid, ammonium chloride is formed.



A. L. Doyle and W. H. Hadley, *Analyst*, **63**, 417 (1938)

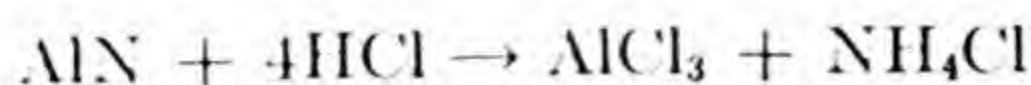
40

AlN

HCl

I-331

Aluminum chloride and ammonium chloride are formed when aluminum nitride is heated with aqueous concentrated hydrochloric acid for twelve to fifteen hours.



Fichter and Spengel, *Z. anorg. Chem.*, **82**, 195 (1913)

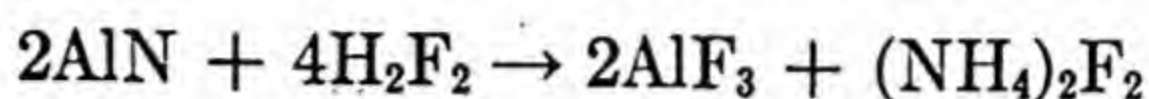
25

AlN

H₂F₂

I-332

Aluminum fluoride and ammonium fluoride are formed after heating aluminum nitride with a concentrated aqueous solution of hydrofluoric acid on the water bath for four and one half hours.



Fichter and Spengel, Z. anorg. Chem., **82**, 196 (1913)

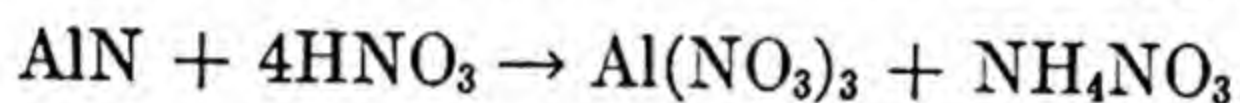
25

AlN

HNO₃

I-333

Aluminum nitrate and ammonium nitrate were formed when nitric acid decomposed aluminum nitride after eleven hours heating.



Fichter and Spengel, Z. anorg. Chem., **82**, 195 (1913)

25

AlN

H₂PtCl₆

I-334

Ammonium chloroplatinate is formed when aluminum nitride is boiled with chloroplatinic acid.



Fichter and Spengel, Z. anorg. Chem., **82**, 197 (1913)

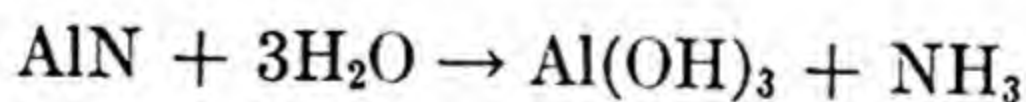
25

AlN

H₂O

I-335

Aluminum nitride is decomposed by water, yielding aluminum hydroxide and evolving ammonia.



Fichter and Spengel, Z. anorg. Chem., **82**, 195 (1913)

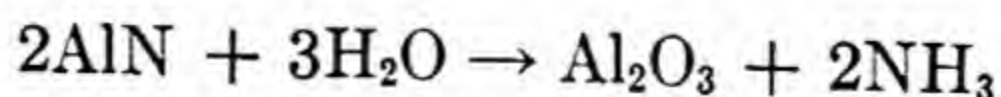
28

AlN

H₂O

I-336

Aluminum nitride reacts with water producing ammonia and aluminum oxide.



S. A. Tucker, J. Ind. Eng. Chem., **5**, 192 (1913)

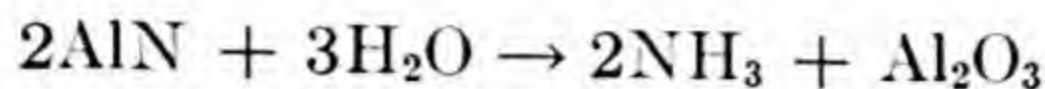
22

AlN

H₂O

I-337

Water reacts with aluminum nitride to produce ammonia and aluminum trioxide.



J. H. Capps, *J. Ind. Eng. Chem.*, **13**, 810 (1921)

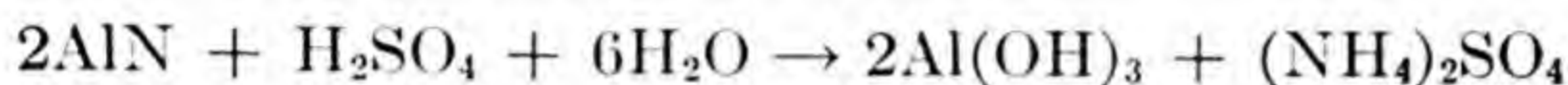
22

AlN

H₂SO₄

I-338

Aluminum hydroxide and ammonium sulfate are formed when aluminum nitride is heated with sulfuric acid.



Badische Anilin and Soda Fabrik, D.R.P. 235868

Ref., *J. Chem. Soc.*, **100**, 1088 (1911)

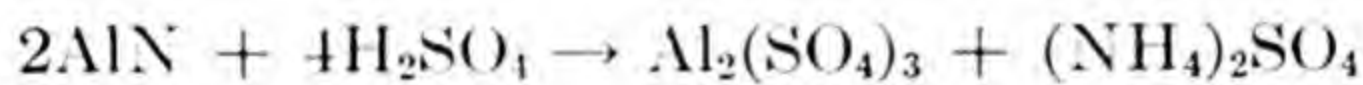
1

AlN

H₂SO₄

I-339

Aluminum sulfate precipitates along with the formation of ammonium sulfate when a dilute aqueous solution of sulfuric acid reacts with aluminum nitride.



Fichter and Spengel, *Z. anorg. Chem.*, **82**, 196 (1913)

25

AlN

KOH

I-340

Potassium aluminate is obtained when aluminum nitride is heated with potassium hydroxide in a closed tube.



Fichter and Spengel, *Z. anorg. Chem.*, **82**, 195 (1913)

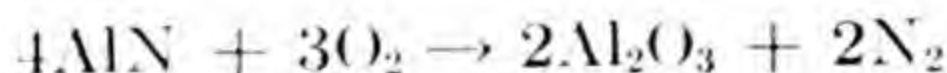
25

AlN

O₂

I-341

Aluminum oxide is formed and nitrogen liberated when aluminum nitride burns in oxygen.



Fichter and Spengel, *Z. anorg. Chem.*, **82**, 198 (1913)

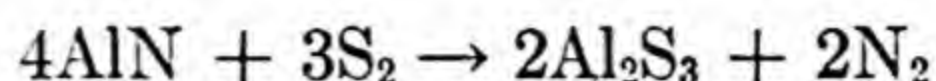
25

AlN

S

I-342

Aluminum sulfide is formed when a mixture of sulfur and aluminum nitride is heated to 380°–400°C. in a closed tube.



Fichter and Spengel, *Z. anorg. Chem.*, **82**, 198 (1913)

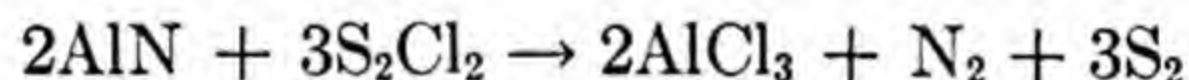
25

AlN

S₂Cl₂

I-343

Aluminum chloride and nitrogen are formed when a stream of carbon dioxide and sulfur monochloride is passed over heated aluminum nitride in a melting tube.



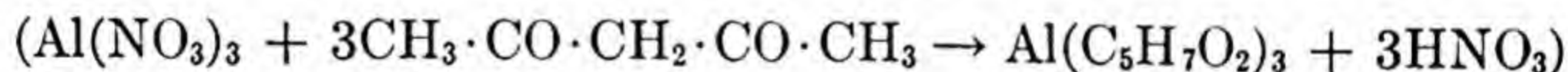
Fichter and Spengel: *Z. anorg. Chem.*, **82**, 198 (1913)

1

Al(NO₃)₃CH₃·CO·CH₂·CO·CH₃

I-344

If aluminum nitrate is refluxed with a slight excess of acetylacetone, ammonia being added from time to time, aluminum acetylacetone is obtained quite pure and in quantitative yield.



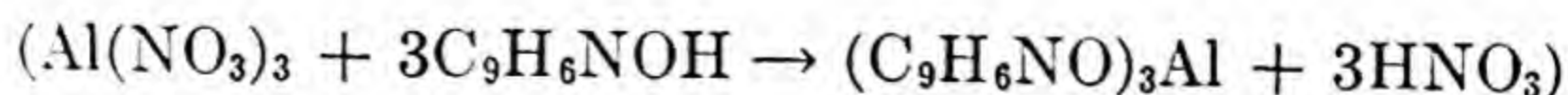
G. T. Morgan and H. D. K. Drew, *J. Chem. Soc. (London)*, **119**, 1061 (1921)

48

Al(NO₃)₃C₉H₆NOH

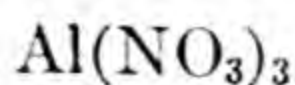
I-345

It is possible to separate aluminum from beryllium when the two are present together in a solution, slightly acidified with acetic acid, by adding 8-hydroxyquinoline. The aluminum precipitates quantitatively.



F. G. Hill, *Ind. Eng. Chem., Anal. Ed.*, **4**, 31 (1932)

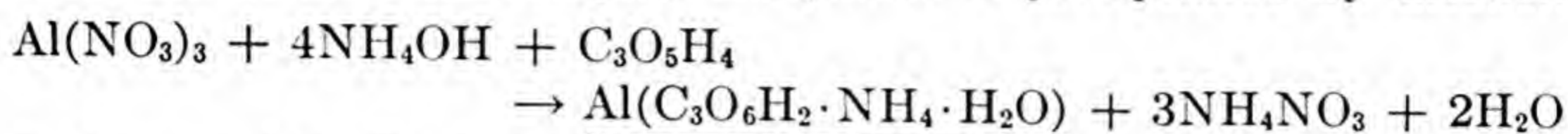
114



I-346

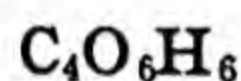


A soluble complex compound is formed when a solution of aluminum nitrate reacts with a solution of ammonium hydroxide in presence of tartronic acid. The complex compound is precipitated by alcohol.



J. Hanus and Ot. Quadrat, Z. anorg. Chem., **63**, 306 (1909)

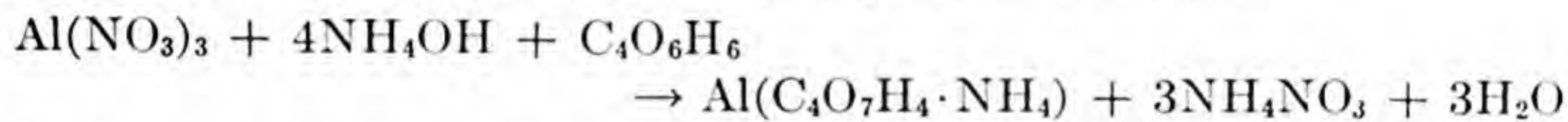
28



I-347



A soluble complex compound is formed when aluminum nitrate solution reacts with ammonium hydroxide solution in presence of tartaric acid. The complex compound is precipitated by alcohol.



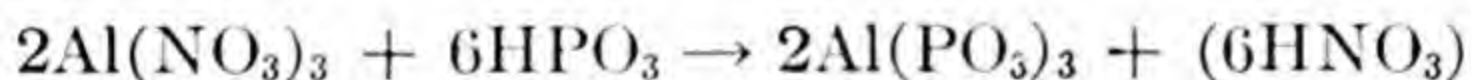
J. Hanus and Ot. Quadrat, Z. anorg. Chem., **63**, 306 (1909)

28



I-348

Aluminum metaphosphate is formed when dry aluminum nitrate is dropped into metaphosphoric acid which has been heated to redness in a platinum dish.



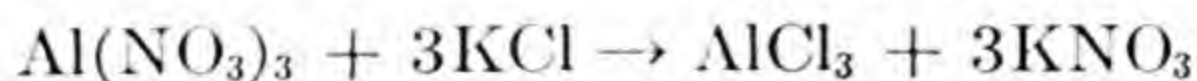
R. Madrell, Ann., **61**, 53 (1847)

25



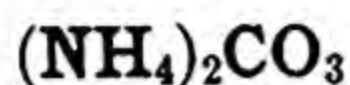
I-349

At normal temperatures aluminum nitrate reacts with potassium chloride to produce aluminum chloride and potassium nitrate.



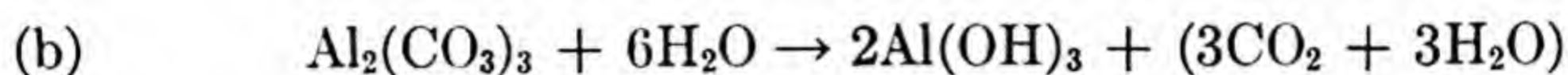
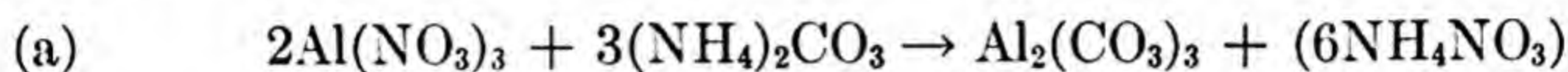
C. Manuelli, Gazz. Chim. Ital, **38**: 151 (1908)

21



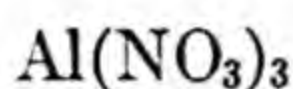
I-350

Ammonium carbonate precipitates aluminum hydroxide from a solution of aluminum nitrate.



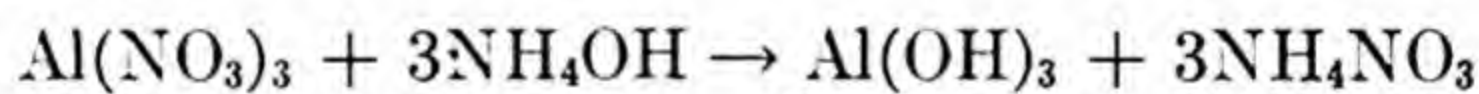
Humphry Davy, Trans. Roy. Soc. (London), **95**, 159 (1805)

105



I-351

Aluminum hydroxide is prepared by precipitation from a solution of aluminum nitrate by ammonium hydroxide.



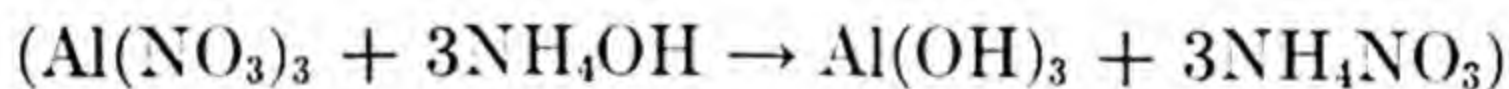
McKee and Burke, Ind. Eng. Chem., **15**, 683 (1923)

1



I-352

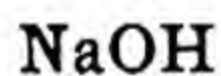
Concentrated solutions of aluminum nitrate are first boiled to expel free HNO_3 and then treated with ammonia. The resulting precipitate is filtered off and washed.



A. Foss and T. Mejdell, U. S. Pat. 1,464,984

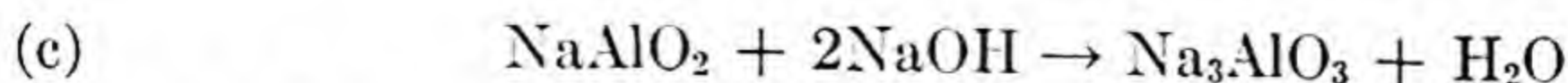
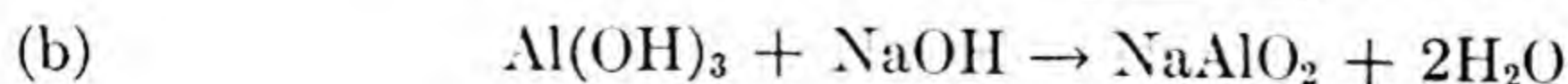
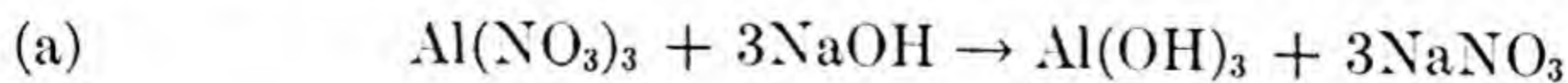
Ref., Chem. Abstr., **17**, 3755 (1923)

25



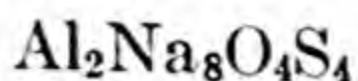
I-353

By addition of sodium hydroxide to a dilute solution of aluminum nitrate the hydrate and two aluminates are formed successively.

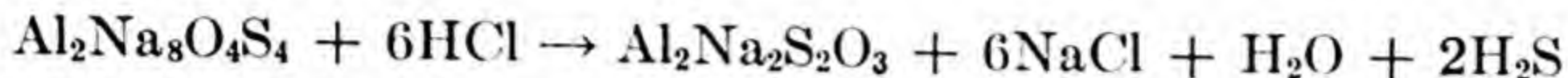


E. Grobet, J. Chim. Phys., **19**, 331 (1921)

69

**HCl****I-354**

Ultramarine blue is formed when dry hydrogen chloride gas acts upon ultramarine white.

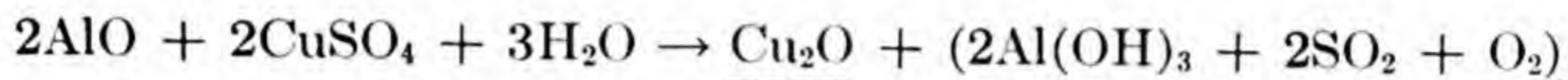


H. Endemann: J. Am. Chem. Soc., **2**, 381 (1880)

1

**CuSO₄****I-355**

Cuprous oxide is precipitated from a solution of copper sulfate by aluminum monoxide.

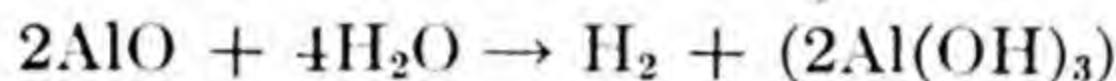


H. F. Keller, J. Am. Chem. Soc., **16**, 839 (1894)

1

**H₂O****I-356**

Aluminum monoxide obtained by reducing Al_2O_3 with magnesium slowly liberates hydrogen from water.

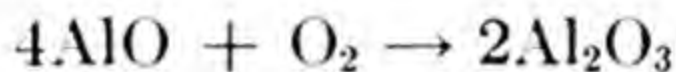


H. F. Keller, J. Am. Chem. Soc., **16**, 839 (1894)

1

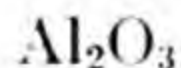
**O₂****I-357**

Aluminum monoxide may be oxidized to aluminum trioxide by heating in air.



H. F. Keller, J. Am. Chem. Soc., **16**, 839 (1894)

1

**C****I-358**

Aluminum is obtained when aluminum oxide is reduced by carbon at 2125°C.



Ruff and Schmidt, Z. anorg. Chem., **117**, 175 (1921)

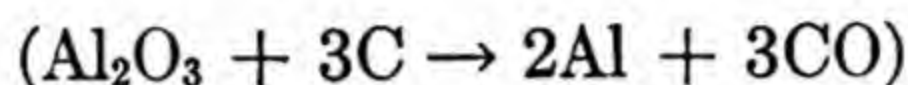
25



C

I-359

When corundum, mixed with charcoal, is subjected to the heat of an electric arc, it is immediately fused, and reduction of the molten mass proceeds rapidly.



Charles F. Mabery: *Am. Chem. J.*, **9**, 11 (1887)

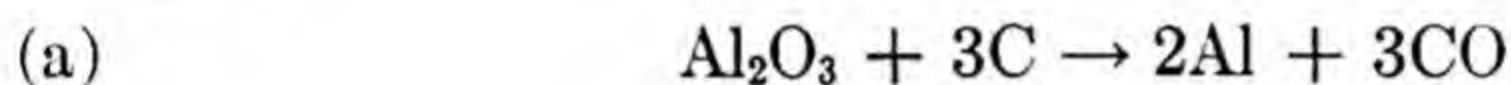
17



C

I-360

Ores of aluminum (Al_2O_3) may be reduced in an electric furnace with carbon. The product is then treated with hydrogen chloride gas at low red heat. The anhydrous aluminum chloride is then volatilized and may be condensed in substantially pure condition. The pure oxide is obtained by treating with water and evaporating the solution to dryness.



Louis Burgess, *Trans. Am. Electrochem. Soc.*, **47**, 318 (1925)

49

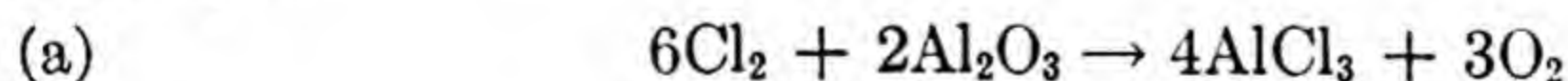


C

I-361

 Cl_2

A mixture of aluminum oxide and carbon when chlorinated at 650°C forms aluminum chloride, oxygen and carbon dioxide. Carbon acts as a catalyst.



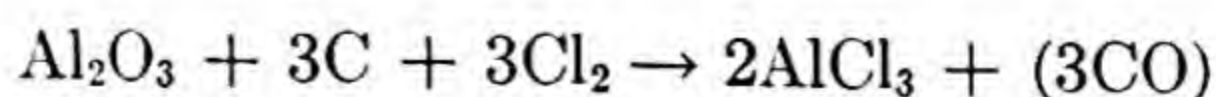
Stover and Constantinescu, *Can. J. Res.*, **14B**, 328 (1936)

94

C + Cl_2

I-362

Aluminum chloride is prepared when chlorine is passed into a mixture of carbon and aluminum oxide stirred with oil and heated to dull redness.



Deville, *Ann. chim. phys.* [3], **43**, 5 (1854)

Ref., *Ann.*, **92**, 255 (1854)

25

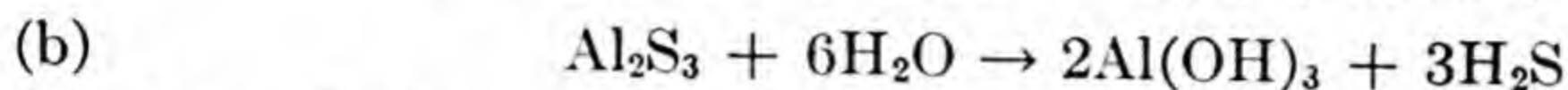
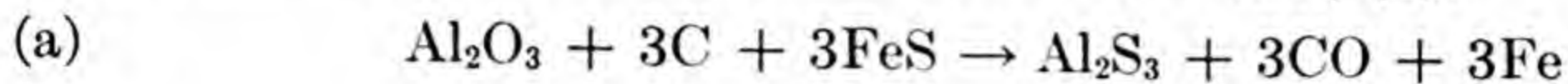


C

I-363

FeS

In the Haglund process for refining aluminous ores the main furnace reaction is approximately as shown in (a). The mixed slag is then cooled, crushed and leached with water and steam, (b).



C. L. Mantell, Chem. Met. Eng., **35**, 746 (1928)

44

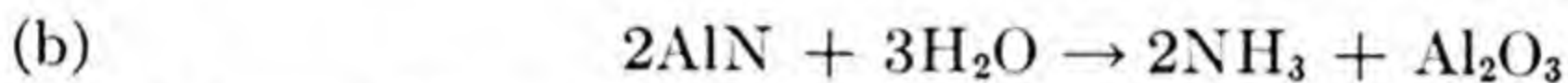
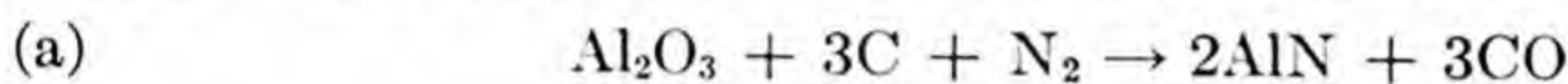


C

I-364

N₂

In the Serpex process for refining aluminous ores the electric resistance furnace charge is heated to 1,600 to 1,800°C. The aluminum nitride is then digested in an autoclave under steam pressure.



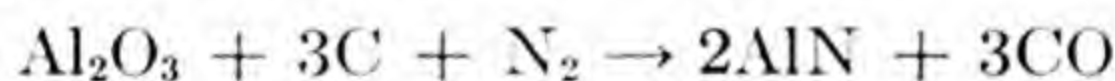
C. L. Mantell, Chem. Met. Eng., **35**, 746 (1928)

44

C + N₂

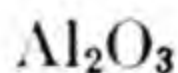
I-365

If aluminum oxide is heated with coal and nitrogen in a Hanell type electric furnace at a temperature of 1800–1900°C, aluminum nitride is formed. The per cent nitrogen is 26–34%.



Helen R. Hosmer, J. Ind. Eng. Chem., **9**, 428 (1917)

22

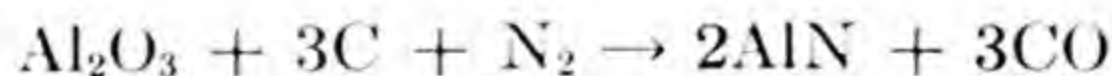


C

I-366

N₂

At temperatures ranging from 1600–2000°C aluminum oxide reacts with carbon and nitrogen forming carbon monoxide and aluminum nitride.



S. A. Tucker, J. Ind. Eng. Chem., **5**, 191 (1913)

22

Ref., Fraenkel, Z. Elektrochem., **19**, 362 (1913)

25

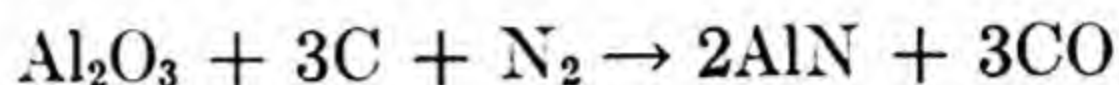


C

I-367

N₂

Aluminum nitride is formed in a reaction between aluminum oxide, carbon, and nitrogen. The reaction is carried out in a specially constructed furnace operating at 15–17 volts and 100 amp., and providing a temperature of 1500°C.



W. Fraenkel, *Z. Elektrochem.*, **19**, 362, 368 (1913)

Ref., W. Fraenkel and J. Silbermann, *ibid.* **22**, 107 (1916)

86

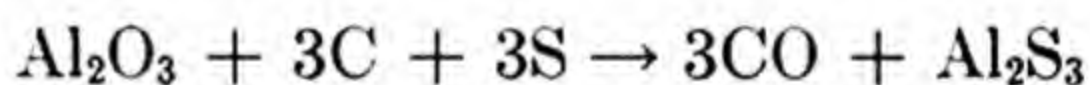


C

I-368

S

To prepare aluminum sulfide fill a clay retort with a mixture of aluminum oxide and charcoal and heat to white heat. Then add slowly the necessary amount of sulfur.



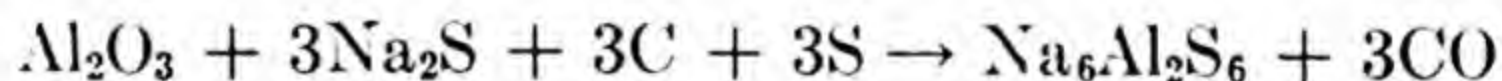
Alfred H. Bucherer, *Z. angew. Chem.*, **5**, 483 (1892)

34

C + S + Na₂S

I-369

Sodium aluminum sulfide is obtained when a mixture of aluminum oxide and sodium sulfide is heated in the presence of powdered carbon and sulfur.



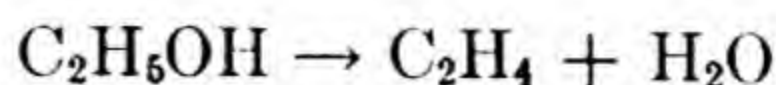
A. Bucherer, *Ber.*, **26**, 25 (1893)

25

C₂H₅OH

I-370

Ethyl alcohol vapors are dehydrated to ethylene catalytically at 350–370°C. by aluminum oxide.



T. Batuecas, *Helv. Chim. Acta*, **1**, 138 (1918)

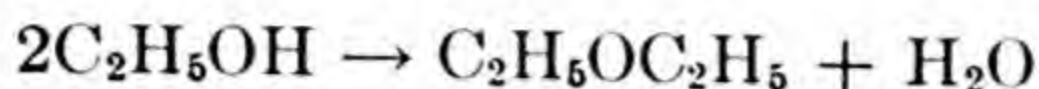
78

T. Batuecas, *J. Chim. phys.*, **22**, 101 (1925)

69

C₂H₅OHAl₂O₃**I-371**

Ethyl alcohol was passed over alumina containing 5.5% water. The temperature during the pyrolysis was at 250°C. A yield of 43% ethyl ether was obtained.

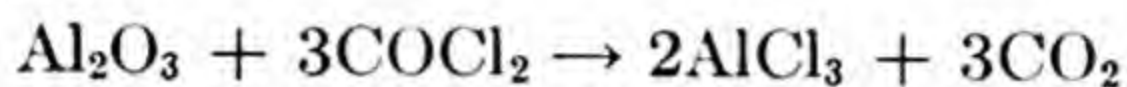


Munro and Horn, Can. J. Res., **12**, 707 (1935)

94

COCl₂Al₂O₃**I-372**

By passing carbonyl chloride over heated aluminum oxide, aluminum chloride is obtained.

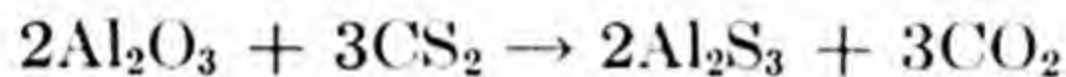


P. P. Budnikoff, Z. Angew. Chem., **37**, 100 (1924)

34

CS₂Al₂O₃**I-373**

Aluminum sulfide is formed when vapors of carbon disulfide are passed over a mixture of aluminum oxide and coal which has been heated to redness.



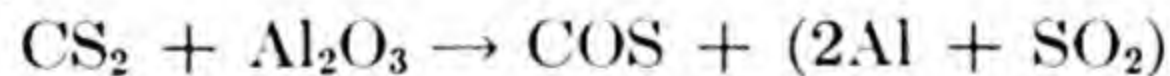
Freymy, Compt. rend., **35**, 27

Ref., Ann., **84**, 227 (1852)

25

CS₂Al₂O₃**I-374**

Carbon disulfide acts on aluminum oxide at a high temperature to form carbonyl sulfide.

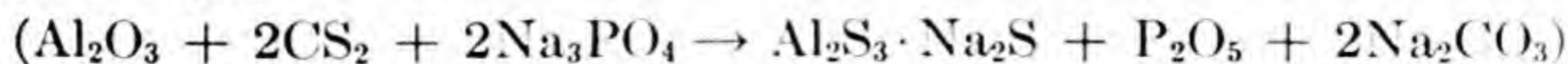


F. C. Phillips, Am. Chem. J., **16**, 345 (1894)

13

CS₂Al₂O₃**I-375****Na₃PO₄**

A double compound is formed when aluminum oxide is heated with a metallic phosphate (sodium phosphate) in an atmosphere of carbon disulfide vapor.

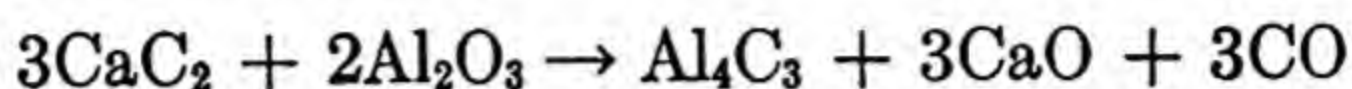


Peniakoff, Ber., **29**, 927 (1896)

25

**CaC₂****I-376**

Yellow crystals of aluminum carbide are formed when aluminum oxide is fused with calcium carbide.



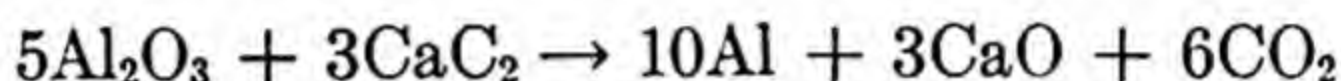
Moissan, *Compt. rend.*, **125**, 839 (1897)

Ref., *J. Chem. Soc.*, (London), **74**, 161 (1898)

25

**CaC₂****I-377**

Aluminum oxide can be reduced to the metal if its mixture with calcium carbide is heated moderately. The reaction is vehement.

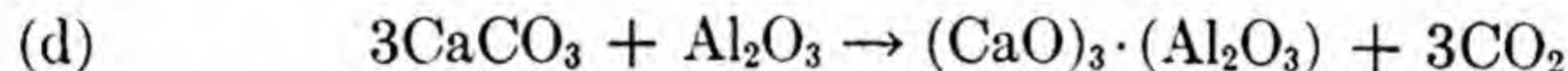
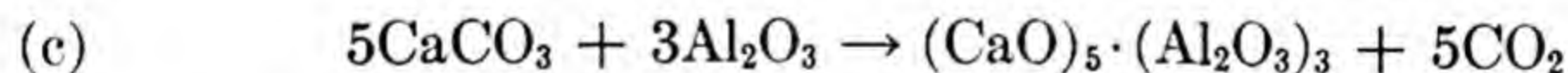
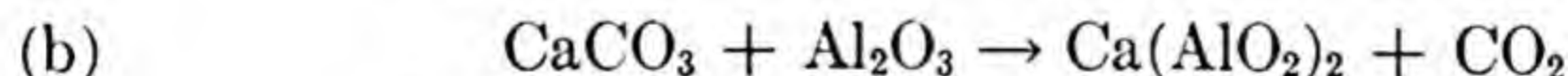
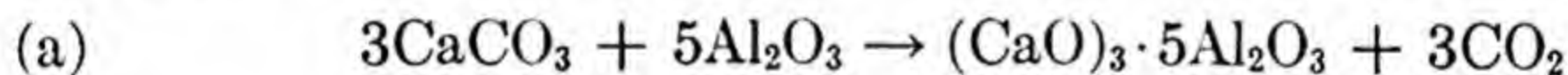


F. v. K  gelgen, *Z. Elektrochem.*, **7**, 577 (1901)

86

**CaCO₃****I-378**

C.P. calcium carbonate and C.P. alumina mixed with a little water and molded into bars and burned in an updraft gas fired kiln 4 hours at $1350^\circ \pm 20^\circ$. The product was ground, remolded and reburned. Final product shows no free lime. Four calcium aluminates were prepared.



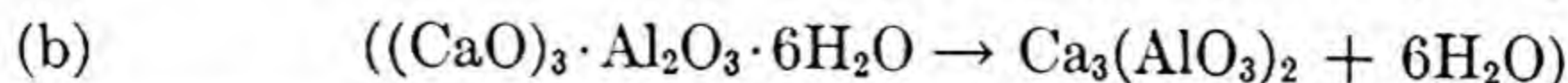
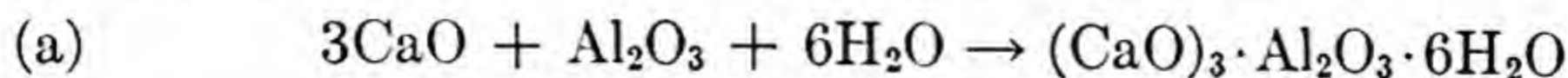
L. S. Wells,

Ref., *B. S., J. Res.* **1**, 962 (1928)

9

**CaO****I-379**

Lime and alumina, when correctly mixed and exposed to steam at 150°C . give the hexahydrate of tricalcium aluminate. This product on ignition gives anhydrous tricalcium aluminate at 1100°C .



Thorvaldson, Grace and Vigfusson, *Can. J. Res.*, **1**, 201 (1929)

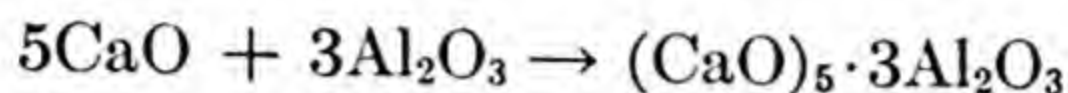
94



CaO

I-380

Pentacalcium trialuminate crystallizes from a melt of this composition at about 1470°C. It can also be formed at a much lower temperature by heating a mixture of lime and alumina.



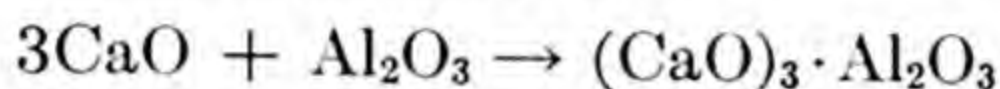
F. M. Lea and T. W. Parker, Trans. Roy. Soc., (London), **234A**, 1-42 (1934-35) 105



CaO

I-381

A mixture of lime and alumina in the solid state forms tricalcium aluminate when heated to less than 1580°C.



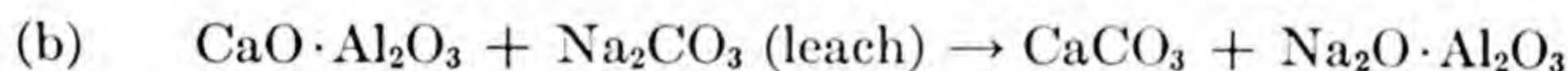
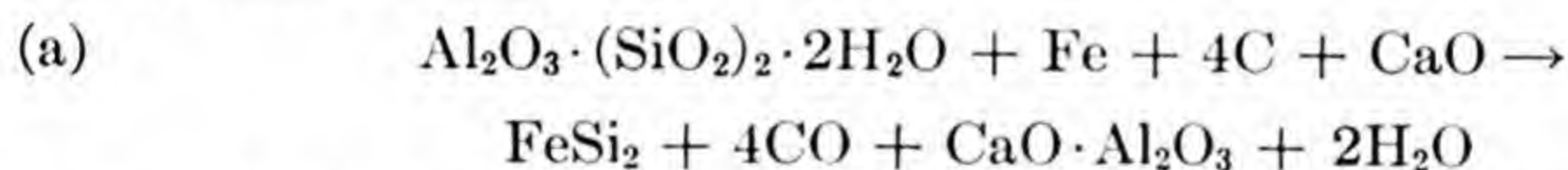
F. M. Lea and T. W. Parker, Trans. Roy. Soc., (London), **234A**, 1 (1934-35) 25



CaO + Fe

I-382

The prospects for the successful reclamation of alumina from clay by the Miguet Process (U. S. Patent 1,376,563) are poor. The following reactions, in which calcium aluminate is tapped off as a slag, proceed to only a small extent:



C. Williams, Bull. Am. Ceram. Soc., **1**, 333 (1922) 85

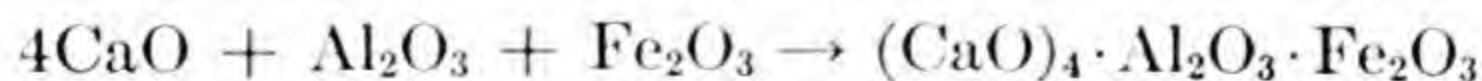


CaO

I-383

Fe₂O₃

Tetracalcium alumino ferrite crystallizes from a melt of the same composition at about 1420°C. It can also be formed at a lower temperature by heating a mixture of lime, alumina, and ferric oxide.



F. M. Lea and T. W. Parker, Trans. Roy. Soc. (London) **234A**, 1-42 (1934-35) 105



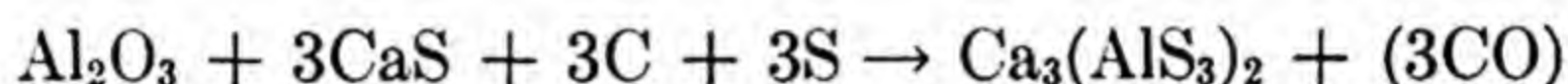
CaS

I-384

C

S

Calcium thioaluminate is obtained when a mixture of calcium sulfide and aluminum oxide is heated in the presence of powdered carbon and sulfur.



A. Bucherer, Ber., **26**, 25 (1893)

25

CaSO₄

I-385

Calcium metaluminate is formed when calcium sulfate is allowed to react with aluminum oxide at 940–950°.



Marchal, Compt. rend., **177**, 1300 (1923)

Ref., J. Chem. Soc. (London), **126**, 44 (1924)

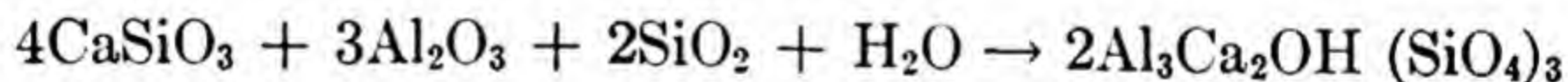
25

CaSiO₃

I-386

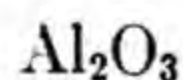
SiO₂H₂O

Evidence shows that during the metamorphosis of minerals in the earth's crust calcium silicate (wollastonite) combines with aluminum oxide (alumina), silicon dioxide (quartz) and water to form hydrated aluminum calcium silicate (zoisite).



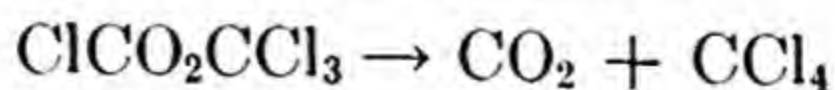
H. von Eckerman, Geol. Fören. Förh., **44**, No. 349,297 (1922)

10

ClCO₂CCl₃

I-387

Trichloromethyl chloroformate decomposes into carbon tetrachloride and carbon dioxide in the presence of alumina.



W. D. Bancroft, J. Ind. Eng. Chem., **13**, 86 (1921)

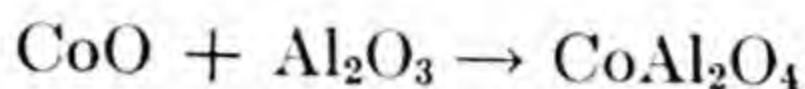
22



CoO

I-388

Thenard's blue is formed when a mixture of cobaltous oxide and aluminum oxide is heated to a high temperature with potassium chloride as a flux.



Hedvall, Upsala Arch. för. Kem. Min. Geol., **5**, No. 16 (1914)

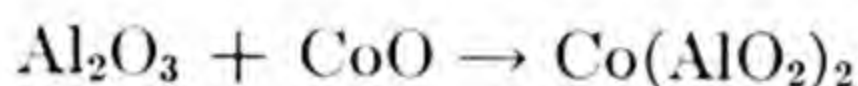
1



CoO

I-389

A blue cobalt aluminate is formed when aluminum oxide is heated above redness but not above 1100°C. with cobaltous oxide.



Hedvall, Z. anorg. Chem., **92**, 306 (1911)

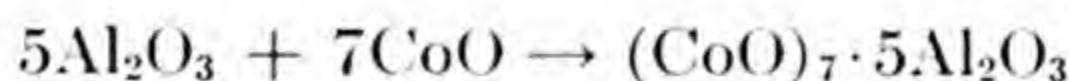
25



CoO

I-390

By fusing a mixture of aluminum trioxide and cobalt monoxide, containing some excess of the latter, at temperatures above 1100°C, a green cobalt aluminate is obtained.



J. A. Hedvall, Z. anorg. Chem., **92**, 311 (1915)

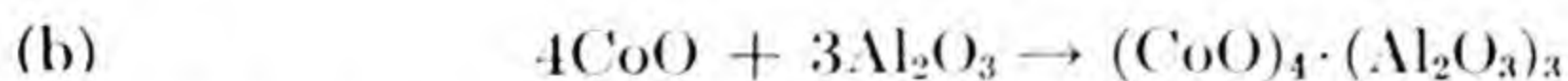
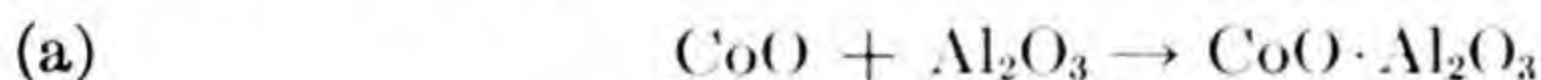
28



CoO

I-391

When aluminum oxide and cobalt oxide are fused together blue cobalt aluminate is formed, but if cobalt oxide is in excess and the temperature rises above 1100°C green cobalt aluminate is formed, (b).

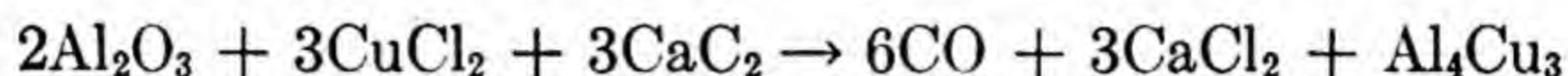


J. A. Hedvall, Ark. Kem., Min., Geol., **5**, Part 16, 6-8 (1914)

10

**CuCl₂****I-392****CaC₂**

A mixture of 20g aluminum trioxide, 40g cupric chloride and 20g calcium carbide is made to react with a primer.

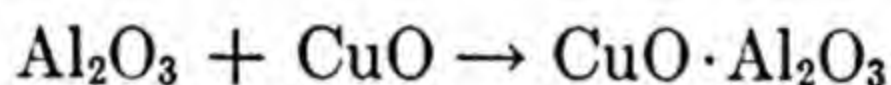


K. Nischk, *Z. Elektrochem.*, **29**, 382 (1923)

86

**CuO****I-393**

By heating aluminum oxide with cupric oxide to 850° for a week cupric aluminate of brown color is obtained.

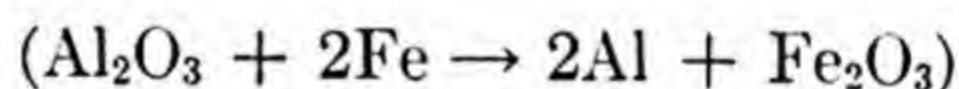


Hedvall and Henberger, *Z. anorg. Chem.*, **116**, 137 (1921)

28

**Fe****I-394**

Iron will reduce aluminum oxide, in the presence of the heat of an electric furnace. The iron will retain some of the aluminum in the form of an alloy.

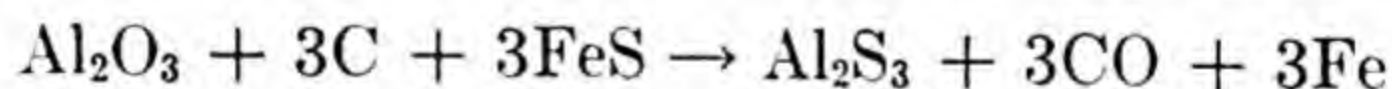


Charles F. Mabery: *Am. Chem. J.*, **9**, 13 (1887)

17

**FeS****I-395**

When a mixture of aluminum oxide, carbon, and ferrous sulfide is heated in an electric furnace, aluminum sulfide is formed.

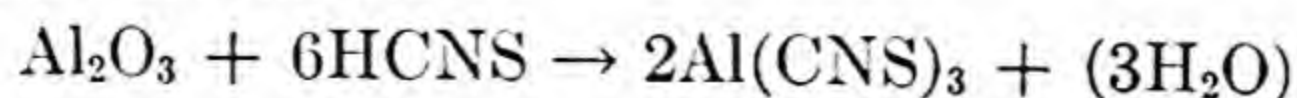


T. R. Haglund, *Ind. Eng. Chem.*, **18**, 67 (1926)

23

**HCNS****I-396**

Aluminum oxide was allowed to react with thiocyanic acid; it formed non-deliquescent octahedra.

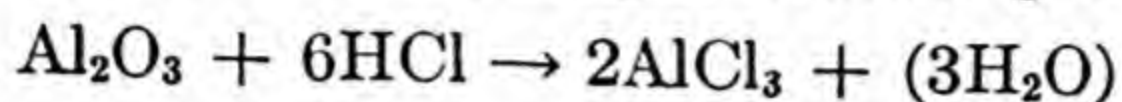


Robert Porrett, Jr., *Trans. Roy. Soc. (London)*, **104**, 552 (1814)

105

**HCl****I-397**

Aluminum chloride is prepared by heating a mixture of aluminum oxide and carbon in the presence of hydrogen chloride gas.

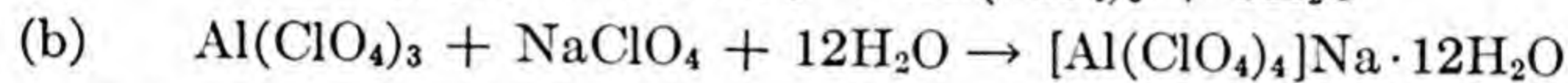
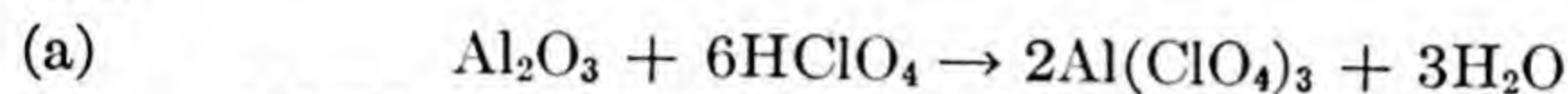


C. A. Taure, Ber., **25**, 816 (1893)

25

**HClO₄****I-398****NaClO₄**

A solution of aluminum oxide in perchloric acid will react with sodium perchlorate, yielding a white colored precipitate, a complex aluminum salt.

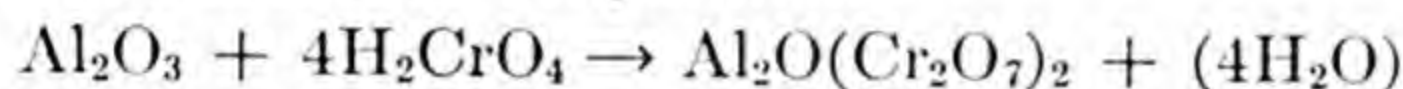


R. F. Weinland and Fr. Eusgraber, Z. anorg. Chem., **84**, 368 (1914)

28

**H₂CrO₄****I-399**

A basic aluminum dichromate was obtained when a solution of aluminum oxide in chromic acid was evaporated.



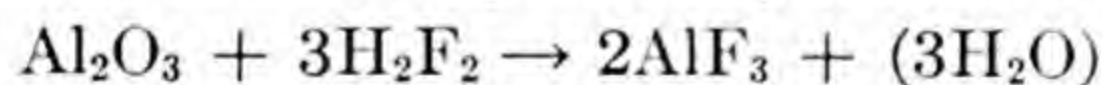
Calcagni, Gazz. chim. ital., **55**, 396 (1925)

Ref., J. Chem. Soc., (London), **128**, 891 (1925)

25

**H₂F₂****I-400**

Aluminum oxide is converted quantitatively into aluminum fluoride when ignited at white heat in vapors of hydrofluoric acid.

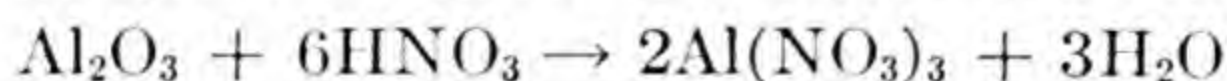


Van Haagen and Smith, J. Am. Chem. Soc., **33**, 1504 (1911)

1

**HNO₃****I-401**

Crystals of aluminum nitrate are formed when strongly heated aluminum oxide is dissolved in hot concentrated nitric acid.



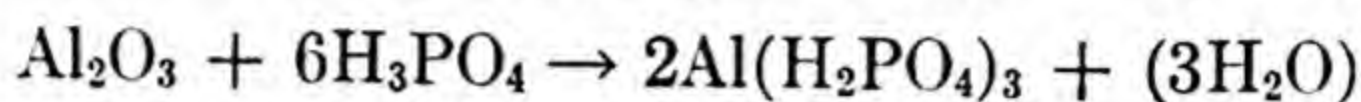
Jovitschitsch, Monatsh. **33**, 9 (1912)

Ref., J. Chem. Soc., (London), **102**, 261 (1912)

25

H₃PO₄**Al₂O₃****I-402**

Primary aluminum hydrogen phosphate is obtained by evaporating a solution of aluminum oxide in phosphoric acid to crystallization.

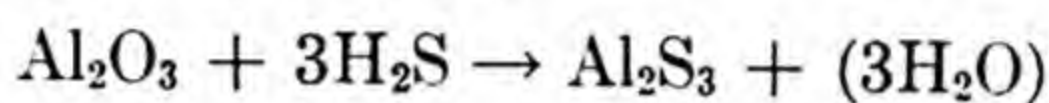


A. Pinner, Ber., **11**, 2284 (1878)

25

H₂S**Al₂O₃****I-403**

Aluminum sulfide is formed when aluminum oxide is heated to a high temperature with hydrogen sulfide.

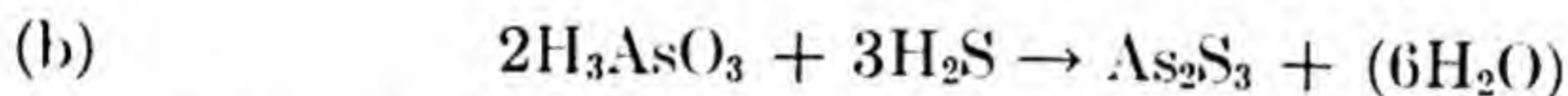
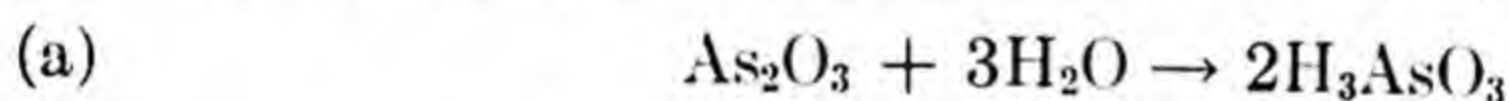


Schumann, Ann., **187**, 311 (1877)

25

H₂S**As₂O₃****I-404**

White arsenic reacted with a solution of hydrogen sulfide and turned yellow, indicating the formation of arsenic sulfide.

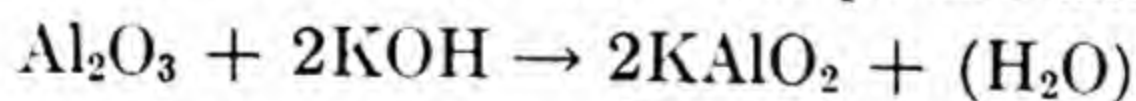


J. G. Schmeiser, Trans. Roy. Soc. (London), **82**, 117 (1892)

105

KOH**Al₂O₃****I-405**

A crystalline precipitate of potassium metaluminate forms when corresponding amounts of aluminum oxide and potassium hydroxide react.



A. Ditte, Compt. rend., **116**, 183

Ref., Ber., **26**, 139 (1893)

25

KOH + HF**Al₂O₃****I-406**

Potassium hexafluoroaluminate may be prepared from the oxide of aluminum. The gelatinous precipitate is filtered and ground to a fine white powder.

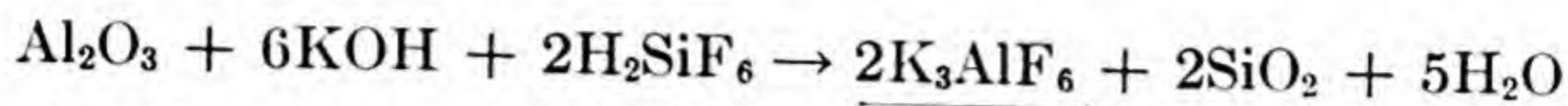


Carter: Ind. Eng. Chem., **22**, 889 (1930)

24

KOH + H₂SiF₆**Al₂O₃****I-407**

Potassium hexafluoroaluminate may be prepared from the oxides of aluminum. The gelatinous precipitate is filtered and ground to a fine white powder.

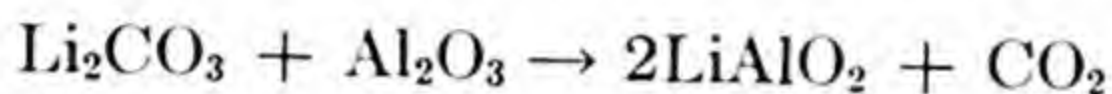


Carter: Ind. Eng. Chem., **22**, 889 (1930)

24

Li₂CO₃**Al₂O₃****I-408**

Fuse a mixture of lithium carbonate and alumina at 900°, then at 1200°. Microscopic plates of lithium metaluminate are formed.

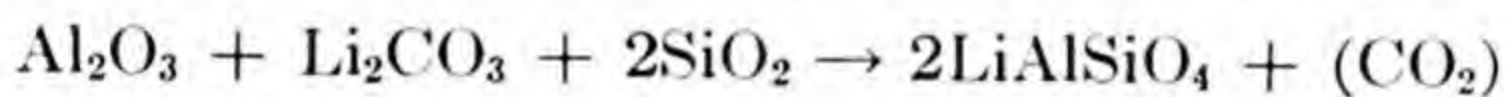


F. M. Jaeger and A. Simek, Proc. K. Akad. Wet., **17**, 239-251, 251-270 (1914)

2

Li₂CO₃ + SiO₂**Al₂O₃****I-409**

If a mixture of aluminum oxide, lithium carbonate and sand is heated in a closed crucible at 1500°C., one gets a lithium aluminum silicate.



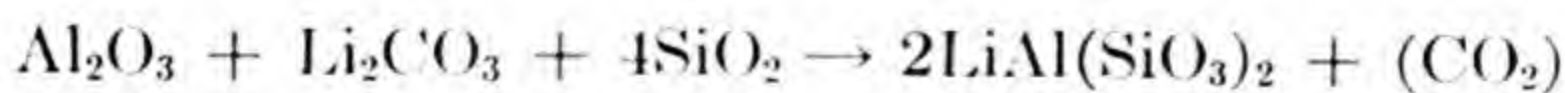
Jaeger and Simek: Proc. K. Akad. Wet., **17**, 239-251, 251-270 (1914)

Ref., J. Chem. Soc., (London) **2**, 1810 (1914)

25

Li₂CO₃**Al₂O₃****I-410****SiO₂**

An aluminum, lithium silicate is obtained if a mixture containing aluminum oxide, an excess of sand, and lithium carbonate is heated to 1500°C.



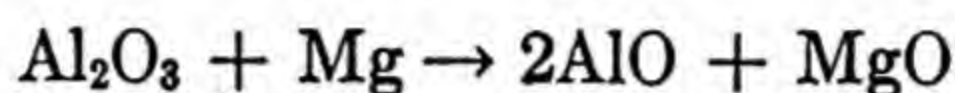
Jaeger and Simek, Proc. K. Akad. Wet., **17**, 239, 251 (1914)

Ref., J. Chem. Soc., **2**, 1810 (1914)

2

**Mg****I-411**

Aluminum monoxide may be prepared by heating aluminum oxide and magnesium in a current of dry hydrogen.

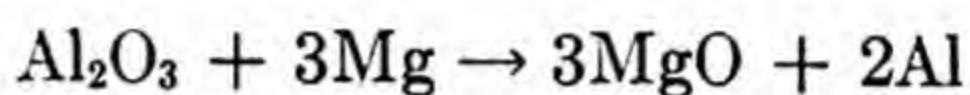


H. F. Keller: J. Am. Chem. Soc., **16**, 839 (1894)

1

**Mg****I-412**

Aluminum oxide is reduced when heated with magnesium in an atmosphere of hydrogen.

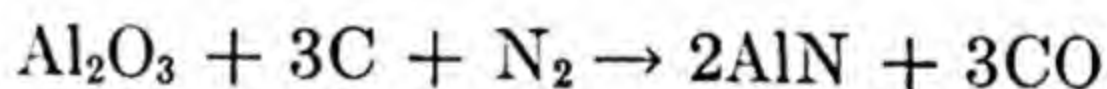


H. F. Keller, J. Am. Chem. Soc., **16**, 838 (1894)

1

**N₂****I-413****C**

When nitrogen is passed over carbon and aluminum oxide in an electric furnace, aluminum nitride is obtained.

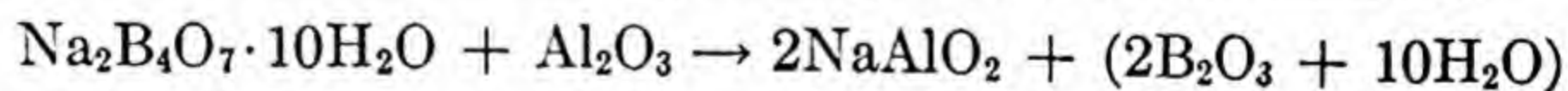


F. Haber, J. Ind. Eng. Chem., **6**, 330 (1914)

22

**Na₂B₄O₇·10H₂O****I-414**

Corundum, which is essentially Al₂O₃, was fused with twice its weight of borax in a platinum crucible yielding sodium metaluminate.

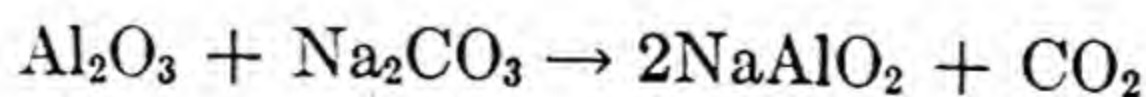


Richard Chenevix, Trans. Roy. Soc. (London), **92**, 329 (1802)

105

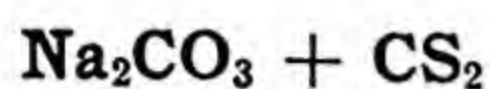
**Na₂CO₃****I-415**

Dry aluminum oxide fused with sodium carbonate yields sodium metaluminate.



Günther Feld, Z. angew. Chem., **39**, 174 (1926)

84



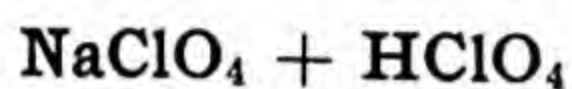
I-416

A double sulfide is formed when aluminum oxide and sodium carbonate are heated in an atmosphere of carbon disulfide vapor.



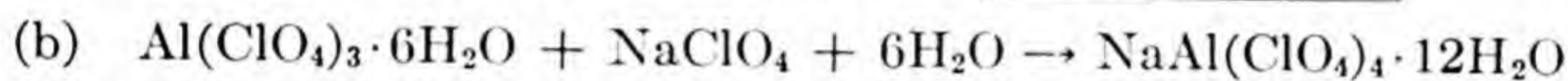
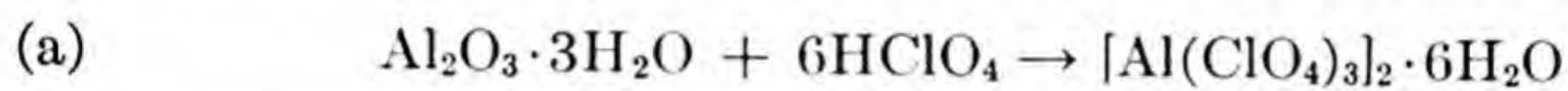
Jaennigen, Ber., **28**, 659 (1895)

25



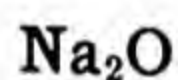
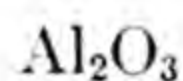
I-417

Colorless, granular, slightly hygroscopic crystals of sodium aluminum tetraperchlorate are formed when hydrated aluminum is dissolved in perchloric acid and then a solution of sodium perchlorate added.



Weinland and Ensgraber, Z. anorg. Chem., **84**, 370 (1914)

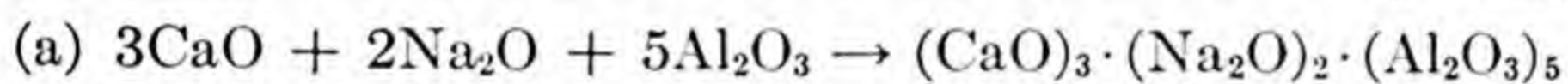
25



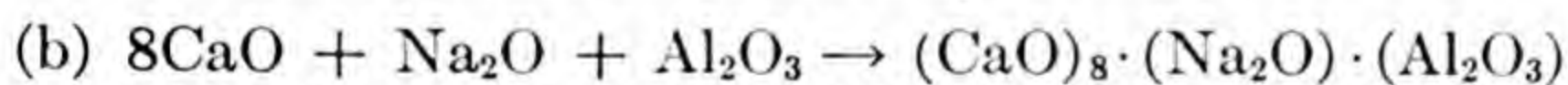
I-418



In the system $\text{Na}_2\text{O} \cdot \text{CaO} \cdot \text{Al}_2\text{O}_3$ there are two ternary compounds.



Does not dissociate or melt up to 1630°C.

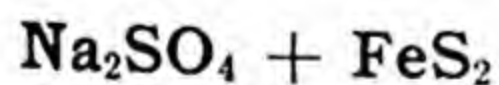
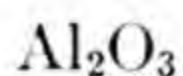


Dissociates into CaO and liquid at 1508°C.

L. T. Brownmiller and R. H. Bogue,

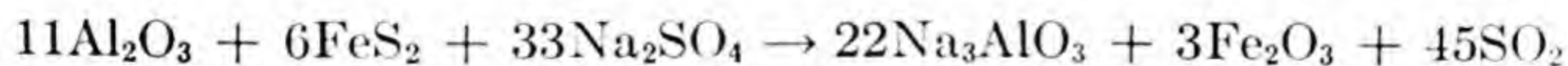
Ref., B. S. J. Res., **8**, 296 (1932)

9



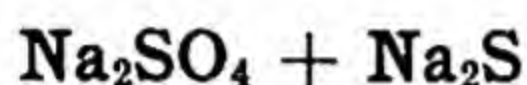
I-419

Sodium orthoaluminate is obtained when a mixture of aluminum oxide and sodium sulfate is heated to redness in the presence of iron pyrite.



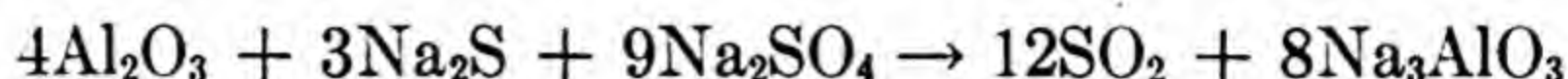
Peniakoff, Ber., **28**, 505 (1895)

25



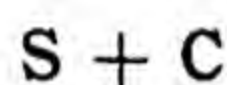
I-420

Sodium orthoaluminate is formed when aluminum oxide and sodium sulfate are heated to redness in the presence of sodium sulfide.



Peniakoff, Ber., **28**, 505 (1895)

25



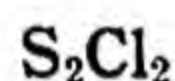
I-421

Aluminum sulfide is formed and carbon monoxide is evolved when sulfur is added to a mixture of aluminum oxide and carbon.



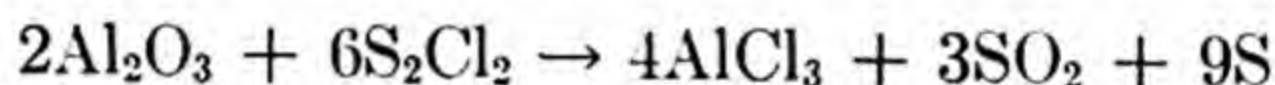
A. H. Bucherer, Z. anorg. Chem., **1**, 483 (1892)

25



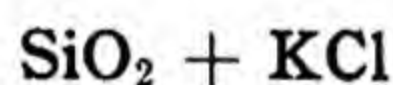
I-422

By passing sulfur monochloride over heated aluminum oxide, aluminum chloride and sulfur are produced.



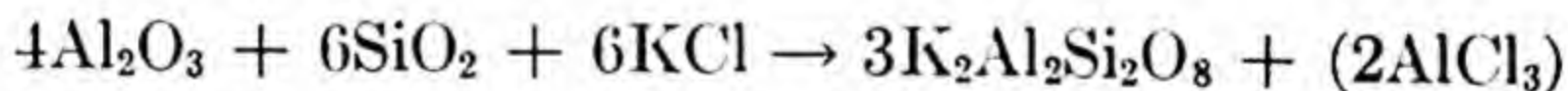
P. P. Budnikoff, Z. angew. Chem., **37**, 100 (1924)

34



I-423

A minutely crystalline product is obtained when a mixture containing aluminum oxide, silica and a large excess of potassium chloride is fused. Similar reactions take place when aluminum oxide and silica are fused with K_2CO_3 , K_2SO_4 and K_2CrO_4



Weyberg, Centr. Min., 395 (1908)

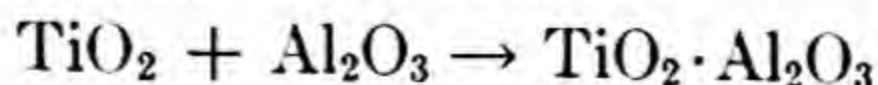
Ref., J. Chem. Soc. (London), **94**, 697 (1908)

25



I-424

The system titanium oxide-aluminum oxide was investigated. Only one compound exists melting at about 1860°C .

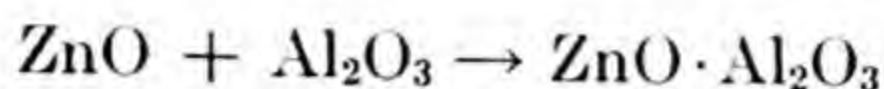


E. N. Bunting, B. S. J. Res., **11**, 725 (1933)

9

**ZnO****I-425**

The binary system zinc oxide-aluminum oxide shows only one compound and a eutectic melting at $1720^\circ \pm 10^\circ\text{C}$. with 83 mole percent of zinc oxide. The melting point of zinc oxide-aluminum oxide is $1950^\circ \pm 10^\circ\text{C}$. at which temperature considerable vaporization of zinc oxide occurs.

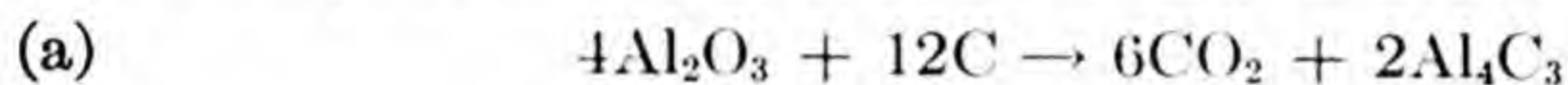


E. N. Bunting, Ref., B. S. J. Res., **8**, 280 (1932)

9

**C****I-426****CuO**

Aluminum trioxide reacts with carbon in an arc of 40 V and 150 Amp to form aluminum carbide, (a). However, if copper oxide is present, no carbide, but an aluminum copper alloy is formed, (b).

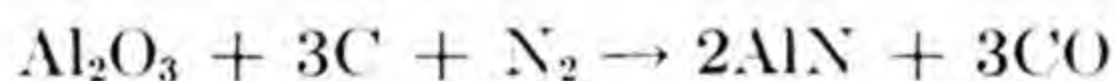


K. Nischk, Z. Elektrochem., **29**, 379, 382 (1923)

86

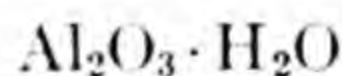
 **Δ** **I-427**

When aluminum oxide is heated at 1500°C with carbon and nitrogen, aluminum nitride is formed.

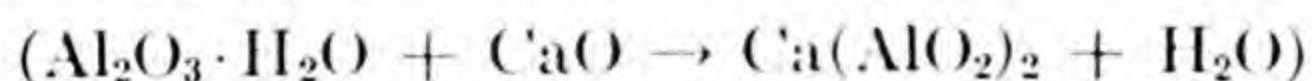


Krase, Thompson and Yee, Ind. Eng. Chem., **18**, 1288 (1926)

23

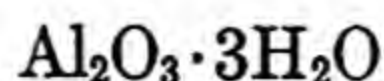
**CaO****I-428**

When bauxite is mixed with limestone in the proper proportions and this mixture fused, a clinker is produced which when pulverized yields a cement essentially calcium aluminate which will stand higher temperatures, more greatly resist attack by acids and chemicals and more quickly harden than Portland cement.

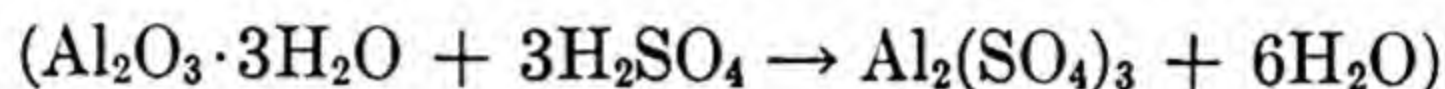


L. Litchfield, Chem. Ind., **48**, 159 (1941)

84

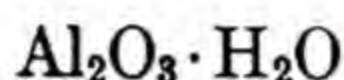
**H₂SO₄****I-429**

Commercial aluminum sulfate is made by digesting bauxite with sulfuric acid, the percentage of chemically combined water in the bauxite being a general index of the acid solubility of the alumina.

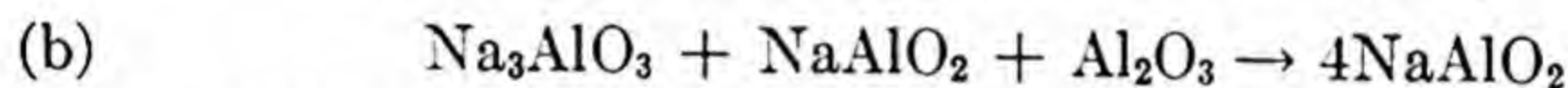
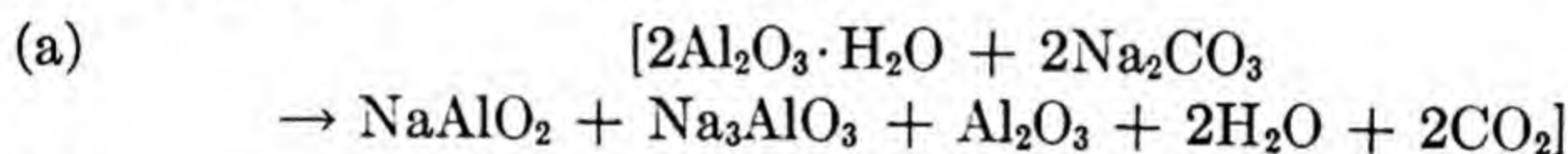


L. Litchfield, *Chem. Ind.*, **48**, 159 (1941)

84

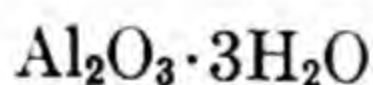
**Na₂CO₃****I-430**

Hydrated aluminum oxide when heated with sodium carbonate to 950° yields both the meta and orthoaluminates (a), which upon heating to 1200° yield the metaluminate, (b).

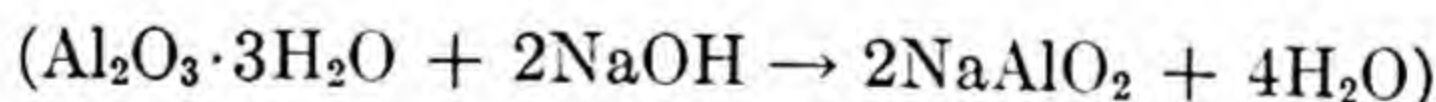


Günther Feld, *Z. Angew. Chem.*, **39**, 174 (1926)

34

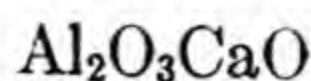
**NaOH****I-431**

Bauxite digested with caustic soda or fused with soda ash produces sodium aluminate which is widely used in the treatment of boiler water and municipal filtration plants to supplement the action of aluminum sulfate.

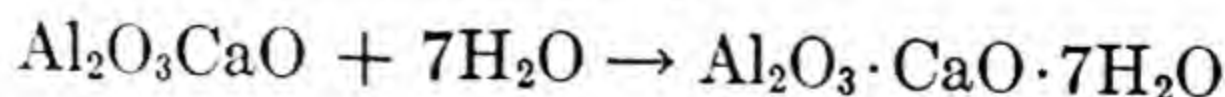


L. Litchfield, *Chem. Ind.*, **48**, 159 (1941)

84

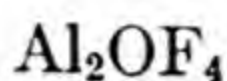
**H₂O****I-432**

The hydration of aluminum oxide-calcium oxide in Portland cement may be best explained by the following equation.



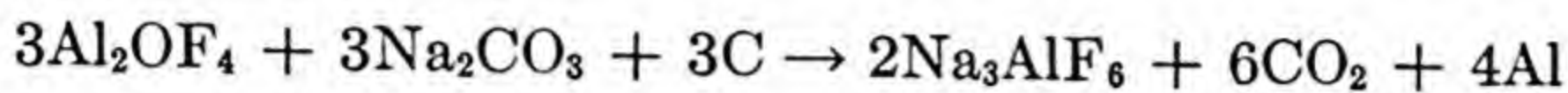
Orazio Rebuffat, *Gazz. Chim. Ital.*, **28**, 246 (1898)

21



I-433

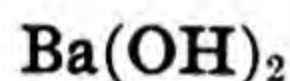
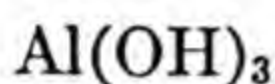
Aluminum and cryolite are obtained when a mixture of sodium carbonate and aluminum oxyfluoride is electrolyzed using a carbon anode and an aluminum cathode.



L. Grabau, D. R. P. 62851

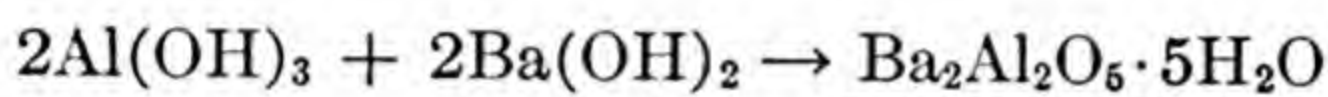
Ref., Ber., **26**, 814 (1893)

25



I-434

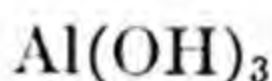
Asymmetric, transparent crystals, which become turbid, are formed when freshly precipitated aluminum hydroxide is boiled with barium hydroxide.



E. Beckmann, Ber., **14**, (1881)

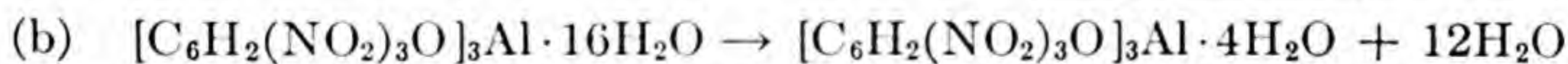
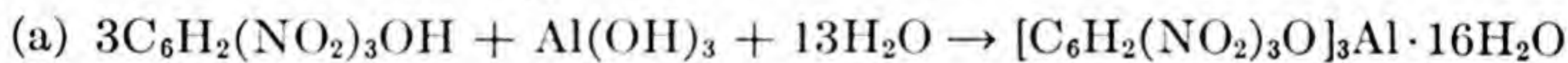
Ref., Ann., **257**, 359 (1890)

25



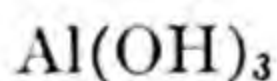
I-435

Aluminum picrate hexadecahydrate is prepared by digesting freshly precipitated aluminum hydroxide with aqueous solution of picric acid for several days, and concentrating the filtrate. On cooling, the salt is deposited in pale yellow needles. The hexadecahydrate forms the tetrahydrate in yellow powder when heated to 80°.



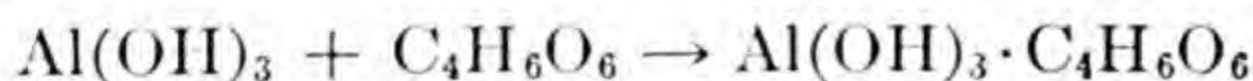
O. Silberrad and H. A. Phillips, J. Chem. Soc. (London), **93**, 483 (1908)

57



I-436

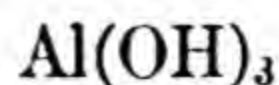
Aluminum hydroxide is soluble in tartaric acid, giving an optically active complex.



E. Darmois, Ann. Chim. Phys., **22**, 247 (1911)

Ref., Yeu Ki Heng, J. Chim. phys., **33**, 356 (1936)

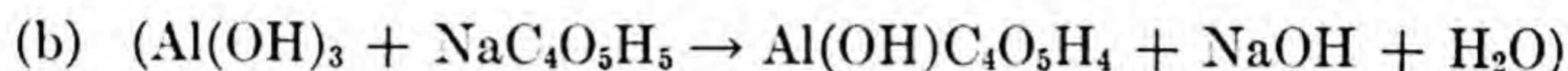
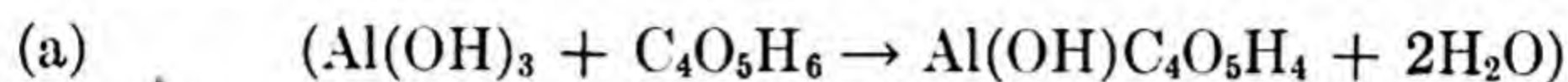
69



I-437

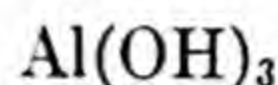


Alumino-malic acid can be crystallized from solutions of aluminum hydroxide in malic acid, (a), or in monosodium malate, (b):



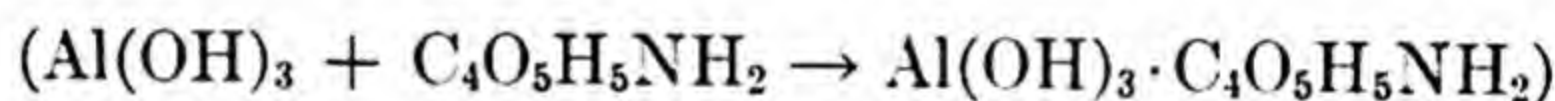
J. L. Delsal, *J. Chim. phys.*, **35**, 350 (1938)

69



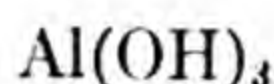
I-438

Aluminum hydroxide forms a levo-rotatory complex with tartramic acid:



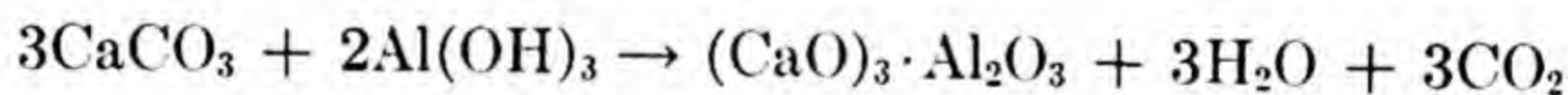
Yeu Ki Heng, *J. Chim. phys.*, **33**, 356 (1936)

69



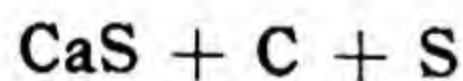
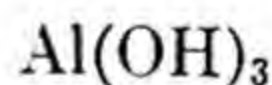
I-439

Calcium carbonate and aluminum hydroxide are mixed in the ratio of 3:2, dried, and finally placed in a furnace at 1300°C. After grinding, it is further treated at 1370°C.



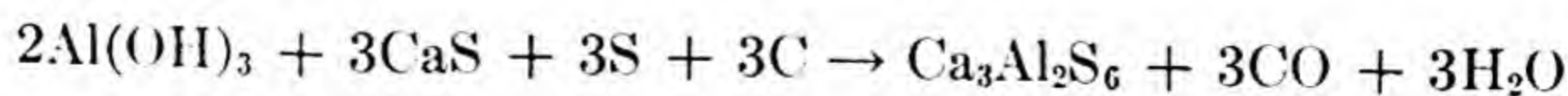
Thorvaldson and Grace, *Can. J. Res.*, **1**, 37 (1929)

94



I-440

Calcium aluminum sulfide is obtained when a mixture of aluminum hydroxide and calcium sulfide is heated in the presence of powdered sulfur and carbon.



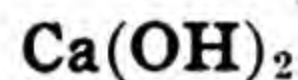
A. Bucherer, *D. R. P.* 63995

Ref., *Ber.*, **26**, 25 (1893)

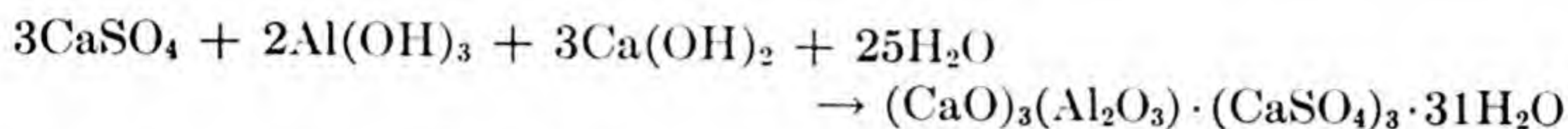
25



I-441

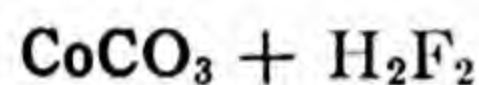
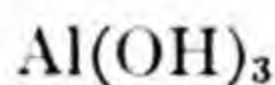


A solution containing calcium hydroxide and calcium sulfate acting on precipitated aluminum hydroxide for about a month forms calcium aluminate-calcium sulfate.



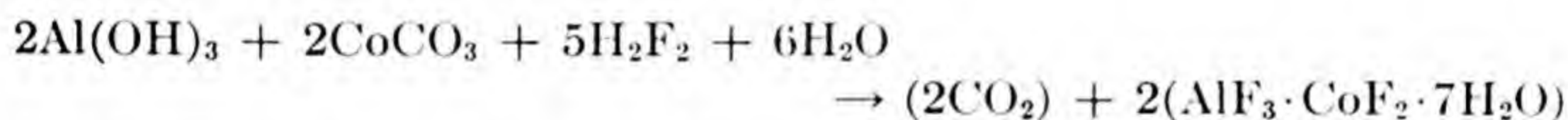
Lerch, Ashton and Bogue, B. S. J. Res., **2**, 721 (1929)

9



I-442

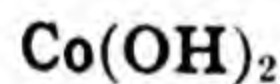
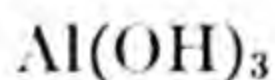
Aluminum cobalt fluoride separates in form of pink crystals when a hydrofluoric acid solution of aluminum hydroxide is treated with a hydrofluoric acid solution of cobalt carbonate and allowed to evaporate over lime at ordinary temperature.



Weinland and Köppen, Z. anorg. Chem., **22**, 266 (1899)

Ref., J. Chem. Soc. (London), **78**, 144 (1900)

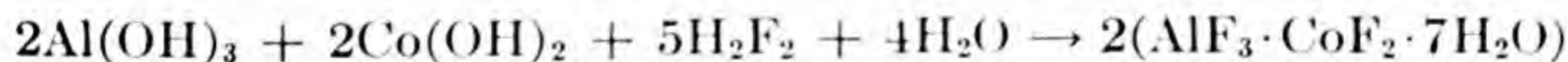
25



I-443



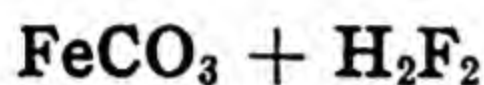
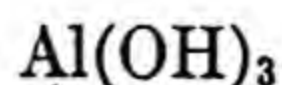
Aluminum cobalt fluoride separates as reddish-white crystals when a hydrofluoric acid solution of aluminum hydroxide is treated with a hydrofluoric acid solution of cobalt hydroxide and allowed to evaporate over lime at ordinary temperature.



Weinland and Köppen, Z. anorg. Chem., **22**, 266 (1899)

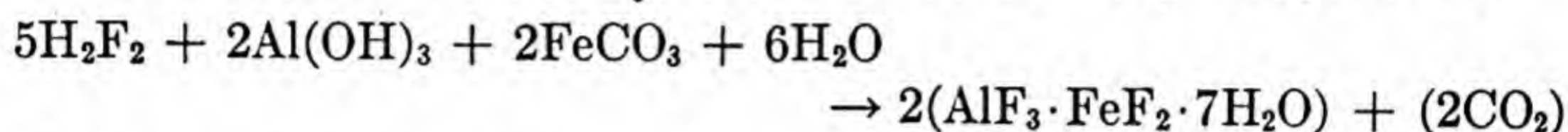
Ref., J. Chem. Soc. (London), **78**, 144 (1900)

25



I-444

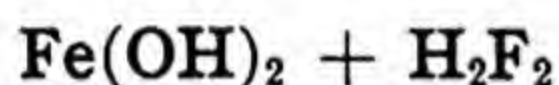
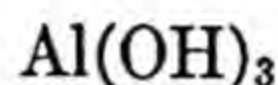
Aluminum ferrous fluoride is formed as greenish white rhomboidal crystals when aluminum hydroxide dissolved in diluted hydrofluoric acid is treated with a hydrofluoric acid solution of ferrous carbonate and allowed to evaporate over lime at ordinary temperature.



Weinland and Köppen, *Z. anorg. Chem.*, **22**, 266 (1899)

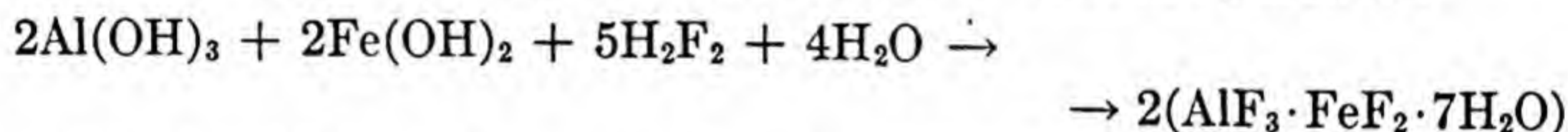
Ref., *J. Chem. Soc. (London)*, **78**, 144 (1900)

25



I-445

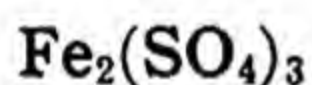
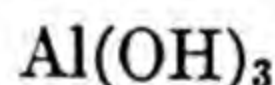
Aluminum ferrous fluoride forms as small, greenish white, rhomboidal crystals when aluminum hydroxide dissolved in dilute hydrofluoric acid is treated with a hydrofluoric acid solution of ferrous hydroxide.



Weinland and Köppen, *Z. anorg. Chem.*, **22**, 266 (1899)

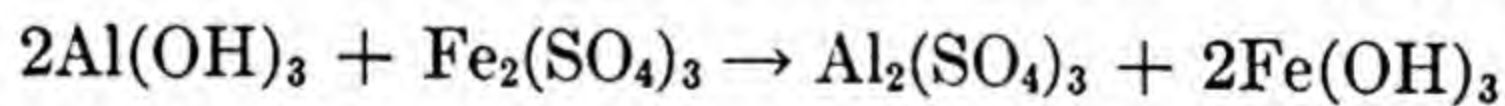
Ref., *J. Chem. Soc. (London)*, **78**, 144 (1900)

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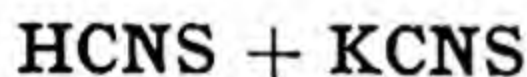
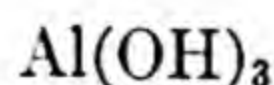
I-446

Freshly prepared aluminum hydroxide precipitates all the iron from a moderately concentrated solution of ferric sulfate in the cold or hot.



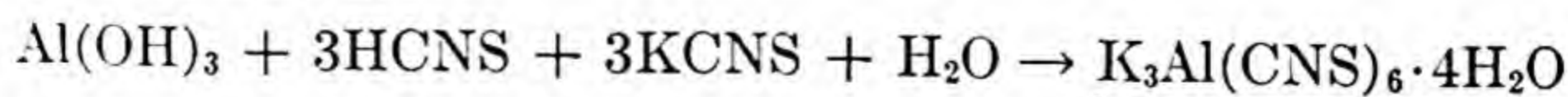
Schneider, *Ber.*, **23**, 1349 (1890)

25



I-447

Potassium aluminum thiocyanate is made when thiocyanic acid is added to freshly precipitated aluminum hydroxide and then potassium thiocyanate added.

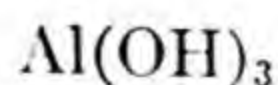


J. Rosler, *Ann.*, **141**, 185 (1867)

Ref., Rosenheim and Cohn, *Ber.*, **33**, 1111 (1900)

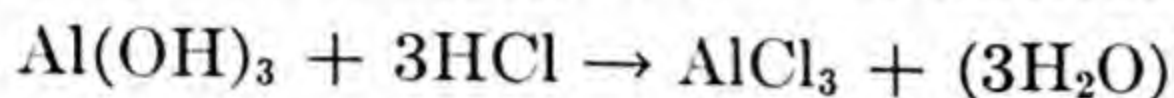
25

HCl



I-448

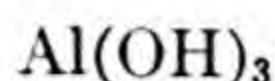
A mixture of materials containing aluminum hydroxide was dissolved in hydrochloric acid, thus forming aluminum chloride.



Charles Hatchett, Trans. Roy. Soc. (London), **88**, 117 (1898)

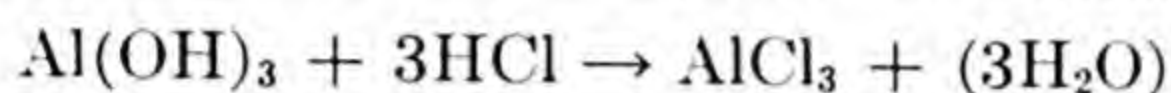
48

HCl



I-449

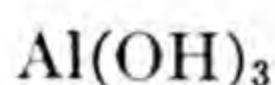
Aluminum hydrate was dissolved in hydrochloric acid.



J. W. Mallette, Trans. Roy. Soc. (London), **171**, 1003 (1881)

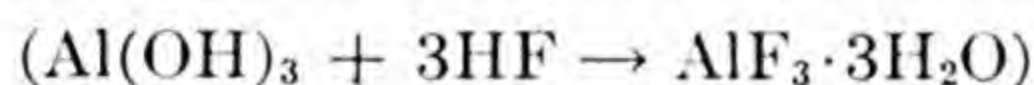
105

HF



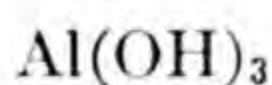
I-450

Pure aluminum hydroxide, containing a known percentage of Al_2O_3 , is dissolved in 37% hydrogen fluoride, used in slight excess. The solution is filtered through a platinum cone and is evaporated on a steam bath. The crystalline fluoride is repeatedly washed with water.



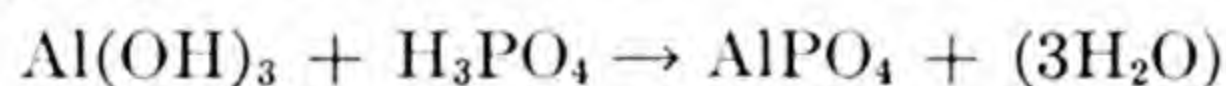
A. V. Novoselova, J. Gen. Chem. (USSR), **10**, 1547 (1940)

60

 H_3PO_4 

I-451

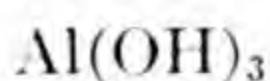
Aluminum phosphate is obtained as a crystalline powder when aluminum hydroxide and phosphoric acid are heated together to 200°C.



A. Schulten, Compt. rend., **98**, 1583

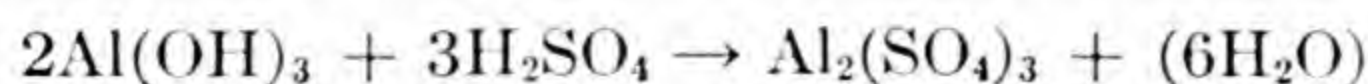
Ref., Ber., **17**, 408 (1884)

25

 H_2SO_4 

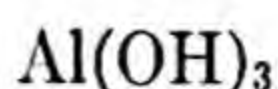
I-452

The mineral hydrargyllite, which is essentially aluminum hydroxide, was found to dissolve in sulfuric acid, forming aluminum sulfate.



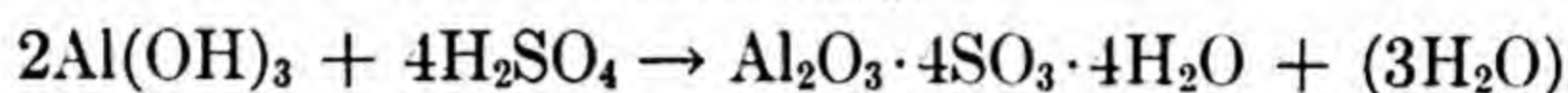
Humphry Davy, Trans. Roy. Soc., (London), **95**, 156 (1805)

105



I-453

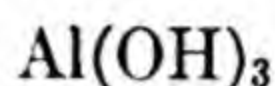
Colorless needles are formed when aluminum hydroxide is boiled with sulfuric acid previously diluted with its own weight of water when the concentration of the acid reaches 75%.



Baud, *Compt. rend.*, **137**, 492 (1903)

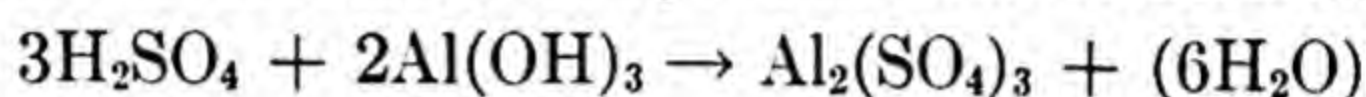
Ref., *J. Chem. Soc. (London)*, **86**, 37 (1904)

25



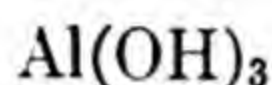
I-454

Sulfuric acid dissolves aluminum hydroxide and forms aluminum sulfate.

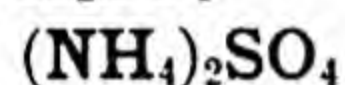


Charles Hatchett, *Trans. Roy. Soc. (London)*, **88**, 117 (1898)

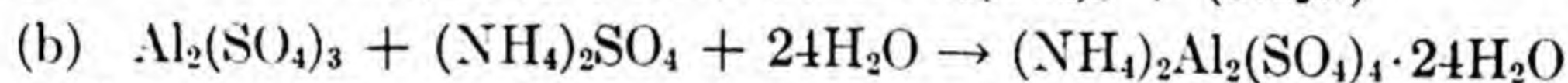
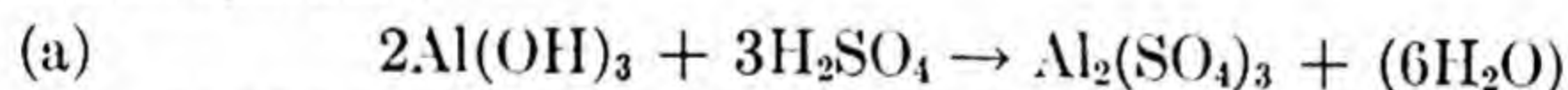
105



I-455

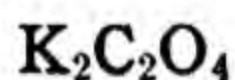


Aluminum hydroxide was dissolved in sulfuric acid, and to this solution an equimolecular solution of ammonium sulfate added. This solution was evaporated and then cooled. Crystals of ammonium alum separated.

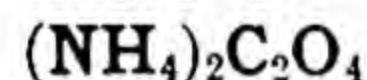


J. W. Mallette, *Trans. Roy. Soc. (London)*, **171**, 1003-35 (1881)

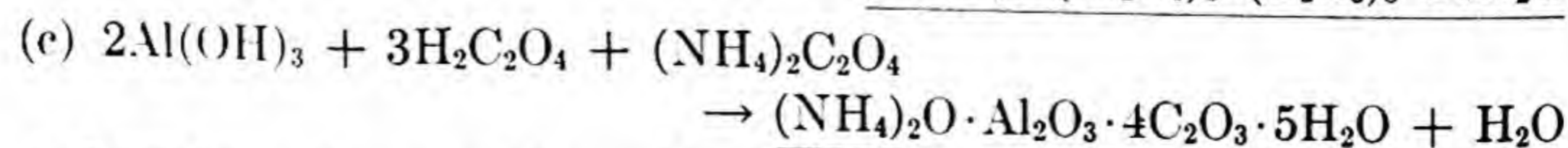
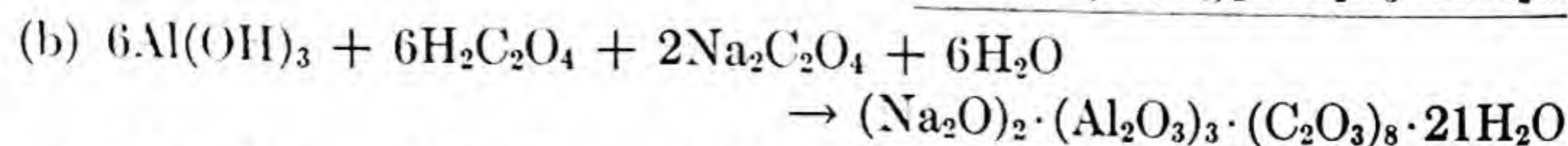
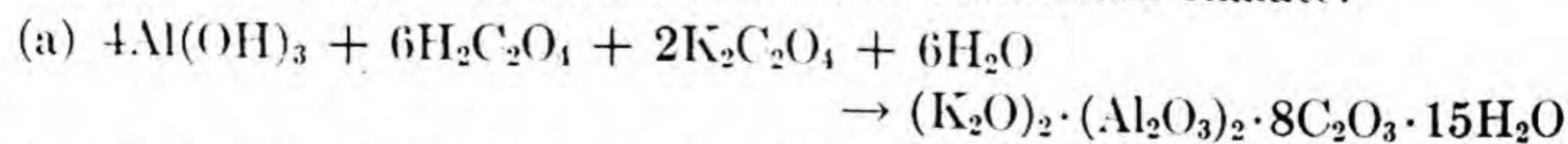
105



I-456

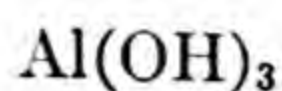


To a known amount of oxalic acid solution which has been saturated with aluminum hydroxide at 100°, potassium oxalate is added until the ratio 3:1 has been reached. White crystals are formed. The same type reaction occurs with sodium oxalate and ammonium oxalate.



A. Rosenheim, *Z. anorg. Chem.*, **11**, 175 (1896)

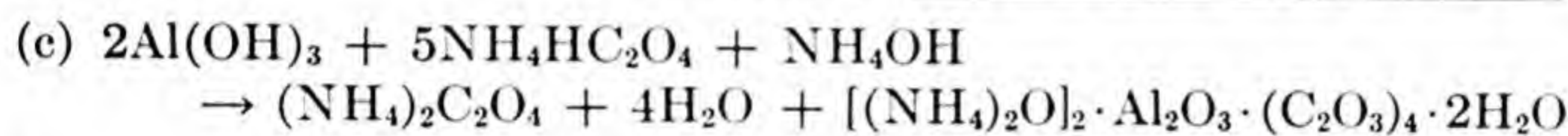
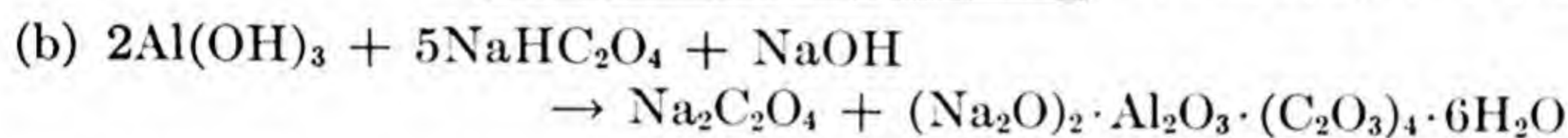
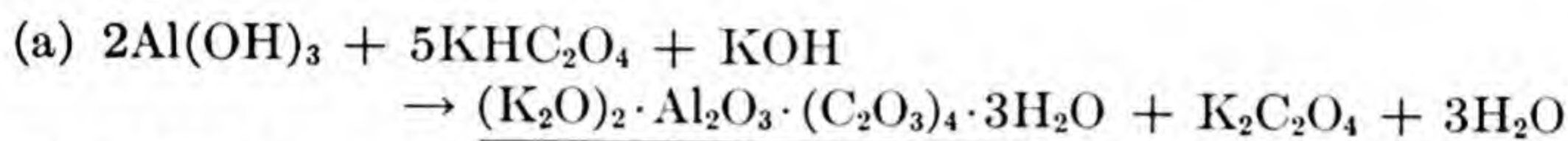
28



I-457

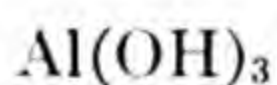


To a concentrated solution of potassium hydrogen oxalate which has been saturated with aluminum hydroxide at 100° potassium hydroxide is added in the ratio 5:1 (oxalate:hydroxide). White crystals are obtained. The same type reaction occurs with sodium hydrogen oxalate and sodium hydroxide and with ammonium hydroxide and ammonium hydrogen oxalate.



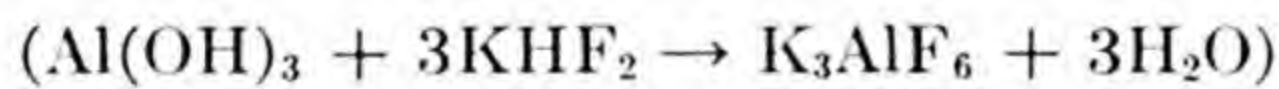
A. Rosenheim, Z. anorg. Chem., **11**, 175 (1896)

28



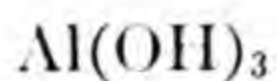
I-458

Freshly precipitated aluminum hydroxide when treated with an aqueous solution of potassium acid fluoride and heated to boiling for 15 minutes forms a gelatinous precipitate of potassium hexafluoroaluminate.



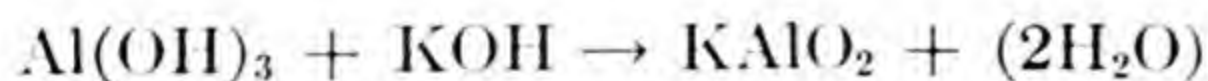
Carter, Ind. Eng. Chem., **22**, 888 (1930)

24



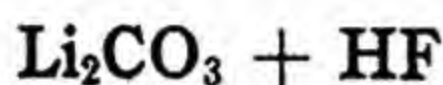
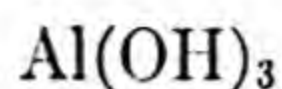
I-459

The mineral hydrargyllite, which is essentially aluminum hydroxide, was found to dissolve in potassium hydroxide solution, forming potassium aluminate.



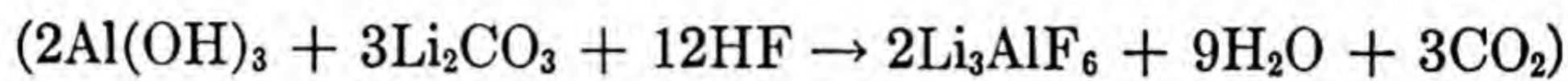
Humphry Davy, Trans. Roy. Soc. (London), **95**, 156 (1805)

105



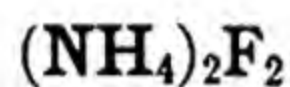
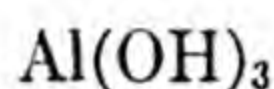
I-460

When a mixture of lithium carbonate and aluminum hydroxide is treated with hydrofluoric acid and digested for several hours, lithium hexafluoroaluminate is produced.



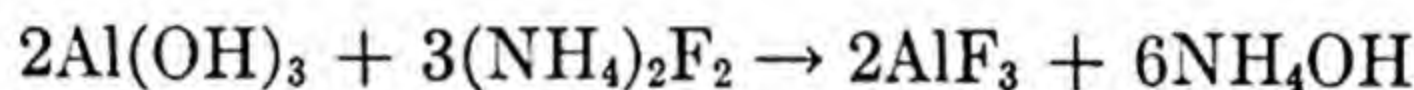
Carter, Ind. Eng. Chem., **22**, 888 (1930)

24



I-461

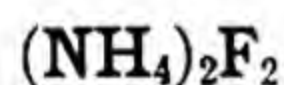
Aluminum fluoride is formed when aluminum hydroxide reacts with ammonium fluoride.



Henrichsen, Ber., **40**, 1498 (1907)

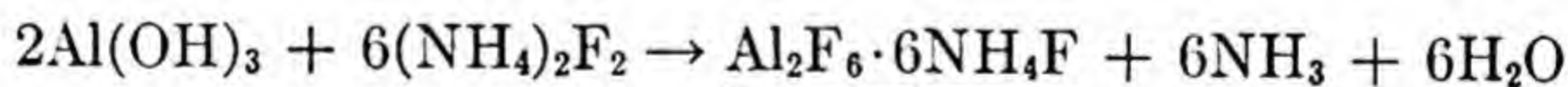
Ref., Z. anorg. Chem., **58**, 83 (1908)

25



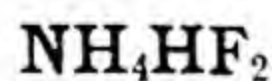
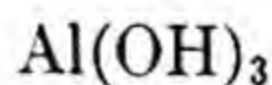
I-462

Aluminum hydroxide will dissolve in a hot concentrated solution of ammonium fluoride yielding white crystals after the evaporation of the excess water.



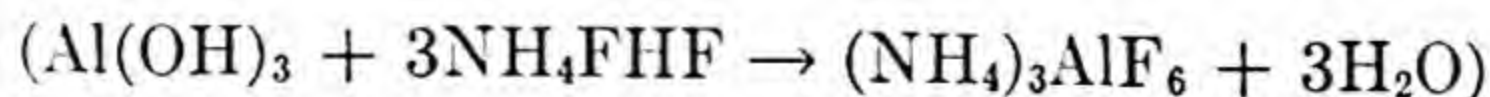
H. V. Helmholt, Z. anorg. Chem., **3**, 115 (1893)

28



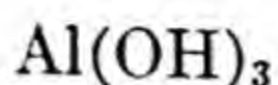
I-463

When aluminum hydroxide is treated with ammonium hydrogen fluoride, and the mixture heated to boiling for 15 minutes a fine white precipitate of ammonium hexafluoroaluminate is formed.



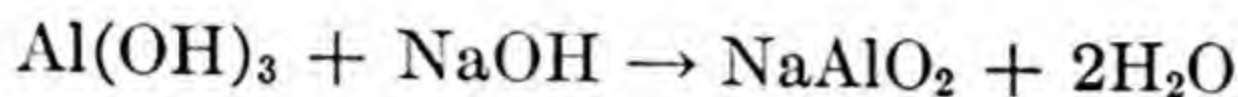
Carter, Ind. Eng. Chem., **22**, 888 (1930)

24



NaOH **I-464**

Aluminum hydroxide is dissolved by NaOH solution, forming the metaluminate.



J. K. Wood, J. Chem. Soc., (London), **93**, 419 (1908) 57

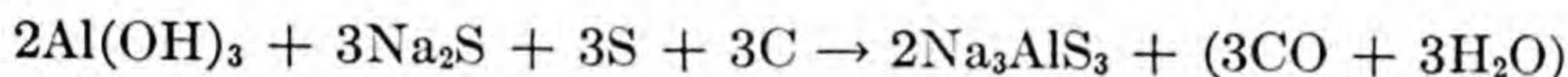


Na₂S **I-465**

C

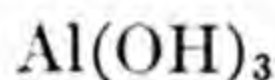
S

Sodium thioaluminate is obtained when a mixture of aluminum hydroxide and sodium sulfide is heated in the presence of powdered carbon and sulfur.



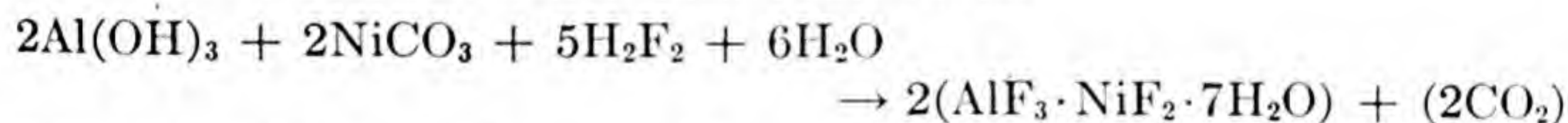
A. Bucherer, D. R. P. 63995

Ref., Ber., **26**, 25 (1893) 25



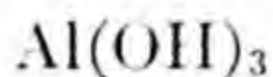
NiCO₃ + H₂F₂ **I-466**

Aluminum nickel fluoride separates as green crystals when a dilute hydrofluoric acid solution of aluminum hydroxide is treated with a hydrofluoric acid solution of nickel carbonate.



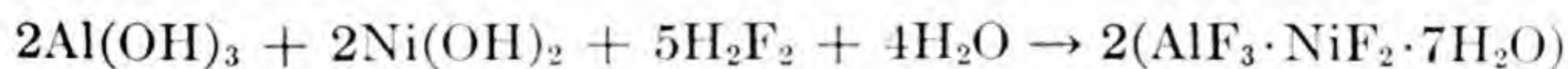
Weinland and Köppen, Z. anorg. Chem., **22**, 266 (1899)

Ref., J. Chem. Soc. (London), **78**, 144 (1900) 25



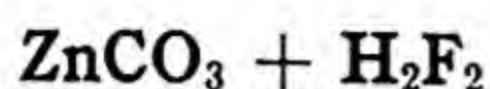
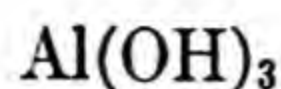
Ni(OH)₂ + H₂F₂ **I-467**

Aluminum nickel fluoride separates as green crystals when a dilute hydrofluoric acid solution of aluminum hydroxide is treated with a hydrofluoric acid solution of nickel hydroxide.



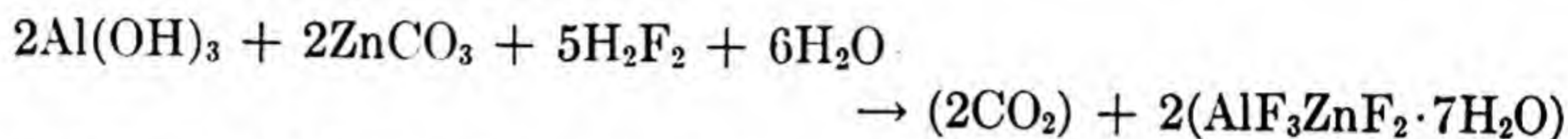
Weinland and Köppen, Z. anorg. Chem., **22**, 266 (1899)

Ref., J. Chem. Soc. (London), **78**, 144 (1900) 25



I-468

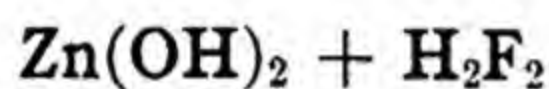
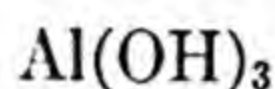
Aluminum zinc fluoride separates as colorless crystals when a hydrofluoric acid solution of aluminum hydroxide is treated with a hydrofluoric acid solution of zinc carbonate and allowed to evaporate over lime at ordinary temperature.



Weinland and Köppen, *Z. anorg. Chem.*, **22**, 266 (1899)

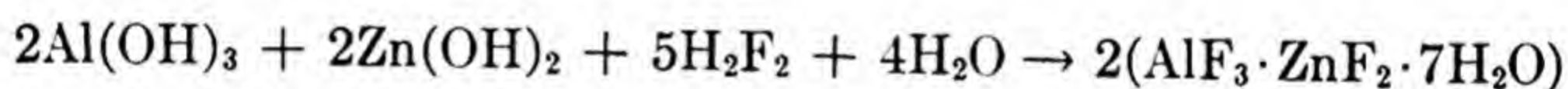
Ref., *J. Chem. Soc. (London)*, **78**, 144 (1900)

25



I-469

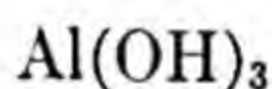
Aluminum zinc fluoride separates as colorless crystals when a hydrofluoric acid solution of aluminum hydroxide is treated with a hydrofluoric acid solution of zinc hydroxide and allowed to evaporate over lime at ordinary temperature.



Weinland and Köppen, *Z. anorg. Chem.*, **22**, 266 (1899)

Ref., *J. Chem. Soc.*, (London), **78**, 144 (1900)

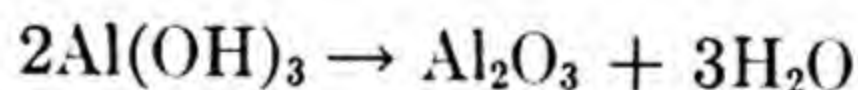
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Δ

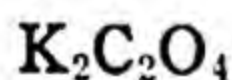
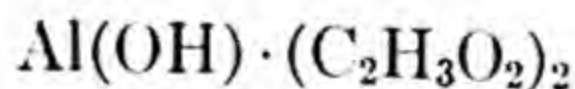
I-470

The mineral hydrargyllite, which is essentially Al(OH)_3 , lost 26.2% on ignition.



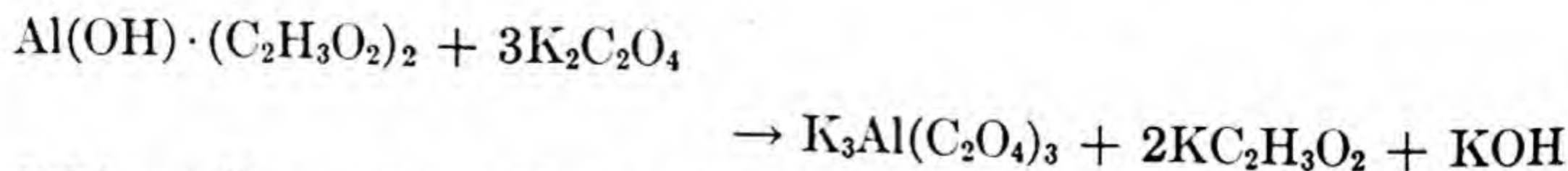
Humphry Davy, *Trans. Roy. Soc. (London)*, **95**, 158 (1805)

105



I-471

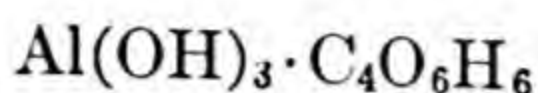
A solution of basic aluminum acetate is rendered alkaline by potassium oxalate.



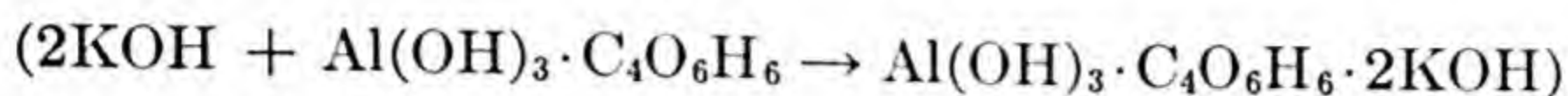
Feigl and Krauss, *Ber.*, **58B**, 398 (1925)

Ref., Thomas and Tai: *J. Am. Chem. Soc.*, **54**, 852 (1932)

1

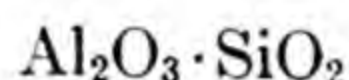
**KOH****I-472**

The neutralization curve of the aluminatartaric acid complex with potassium hydroxide shows the existence of a complex, which is stable in weakly basic solution:



Yeu Ki Heng, *J. Chim. phys.*, **33**, 356 (1936)

69

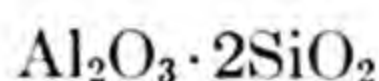
**Δ****I-473**

Pure kaynite softens at about 1810°C, and when heated above 1810°C it decomposes into mullite. This decomposition is accompanied by an expansion corresponding to a specific gravity decrease from 3.5 to 2.9.

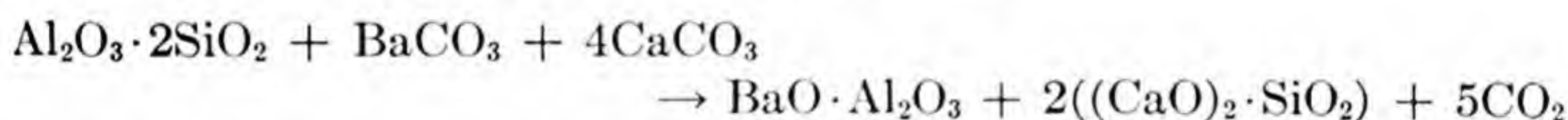


G. R. Pole and D. Moore, *Bull. Am. Ceram. Soc.*, **17**, 355 (1938)

85

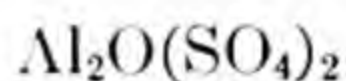
**BaCO₃****I-474**

Barium carbonate reacts in the melt with alumino silicate (in the presence of calcium carbonate) to form three barium aluminates, namely $\text{BaO} \cdot \text{Al}_2\text{O}_3$, $(\text{BaO})_2 \cdot \text{Al}_2\text{O}_3$, and $(\text{BaO})_3 \cdot \text{Al}_2\text{O}_3$.

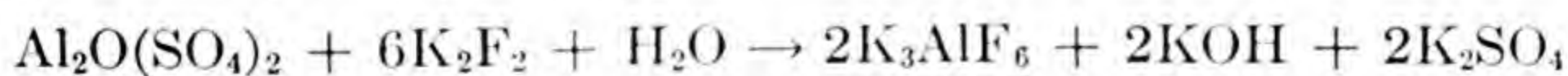


V. Gerber, *Z. Elektrochem.*, **25**, 203 (1919)

86

**K₂F₂****I-475**

Potassium hexafluoroaluminate is precipitated when a solution of aluminum oxysulfate is treated with potassium fluoride in solution in presence of a base and phenolphthalein.



T. Craig, *J. Soc. Chem. Ind.*, **30**, 184 (1911)

Ref., *Z. anal. Chem.*, **52**, 117 (1913)

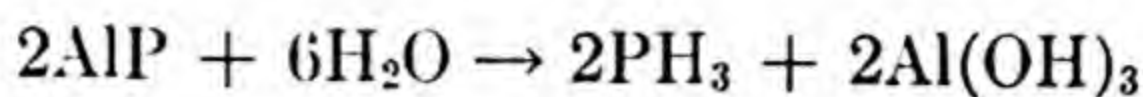
25

AlP

H₂O

I-476

Phosphine is evolved and aluminum hydroxide is formed when aluminum phosphide reacts with water.



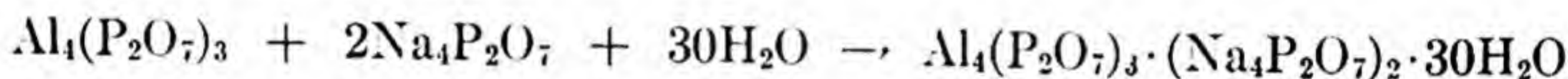
L. Franck: *Z. anal. Chem.*, **37**, 173 (1898)

25

Al₄(P₂O₇)₃Na₄P₂O₇

I-477

When aluminum pyrophosphate is added to a sodium pyrophosphate solution as long as it will dissolve, the resulting solution yields after some time wart-like groups of microscopic prisms of the double pyrophosphate of aluminum and sodium containing thirty molecules of water of hydration.



C. N. Pahl, *K. Sv. Vet. Akad. Handl. Öfvers.*, **30**, No. 7, 31 (1873)

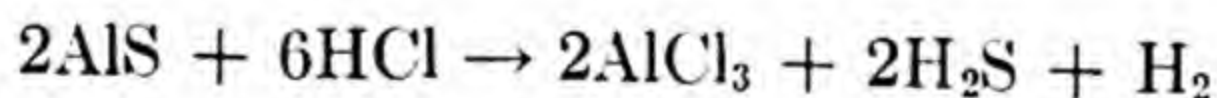
10

AlS

HCl

I-478

Aluminum monosulfide yields hydrogen when treated with hydrochloric acid.



Biltz and Caspari, *Z. anorg. Chem.*, **71**, 182 (1911)

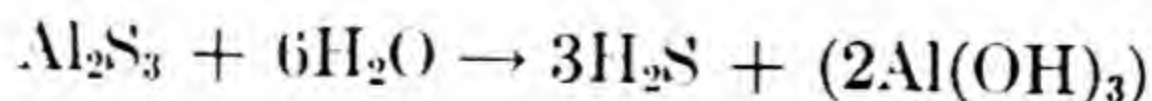
Ref., C. H. Desch, *J. Chem. Soc.*, (London), **100**, 805 (1911)

25

Al₂S₃H₂O

I-479

When water is allowed to drop steadily upon aluminum sulfide in an H₂S generator a slow steady stream of acid vapor-free gas is obtained. The reaction stops when the flow of water is discontinued.

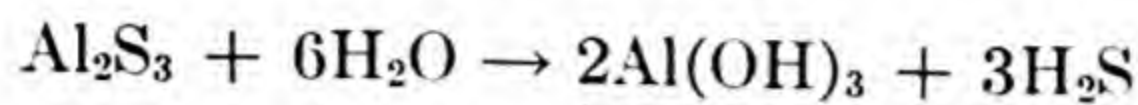


Fonzes and H. Deacon, *Bull. Soc. Chim.*, **1**, 36 (1907)

31

H₂O**I-480**

Aluminum sulfide slag is decomposed when treated with water to form aluminum hydroxide and hydrogen sulfide.



T. R. Haglund, Ind. Eng. Chem., **18**, 67 (1926)

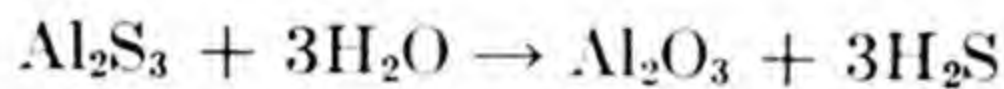
Ref., O. Schumann, Ann., **187**, 286 (1877)

23

25

H₂O**I-481**

Dialuminum trisulfide is decomposed by water, aluminum oxide is obtained.

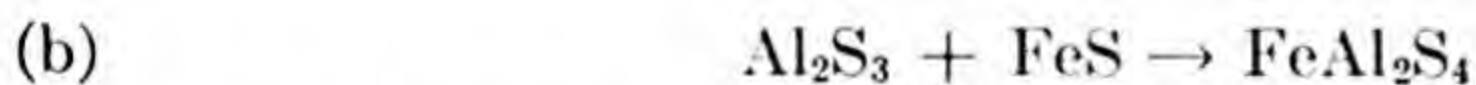
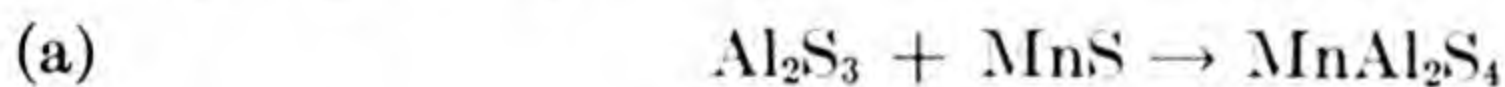


W. Biltz and F. Caspari, Z. anorg. Chem., **71**, 182 (1911)

28

MnS**I-482****FeS**

Aluminum sulfide reacts with both manganese sulfide and ferrous sulfide at very high temperatures. Crystalline deposits are formed.



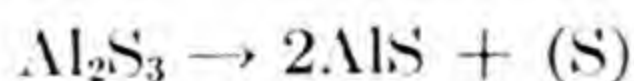
M. Houdard, Compt. Rend., **144**, 801 15, 4 (1907)

Ref., R. Marquis, Bull. Soc. Chim., (4), **1**, 843 (1907)

31

Δ**I-483**

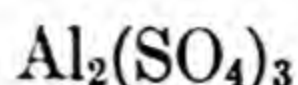
Aluminum monosulfide is formed when aluminum sulfide is heated to 2100°C.



Biltz and Caspari, Z. anorg. Chem., **71**, 182 (1911)

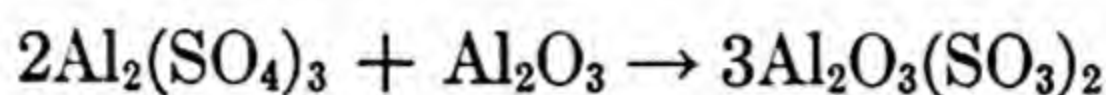
Ref., C. H. Desch, J. Chem. Soc. (London), **100**, 804 (1911)

25



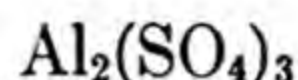
I-484

Basic aluminum sulfate is formed when aluminum oxide is dissolved in a solution of aluminum sulfate.



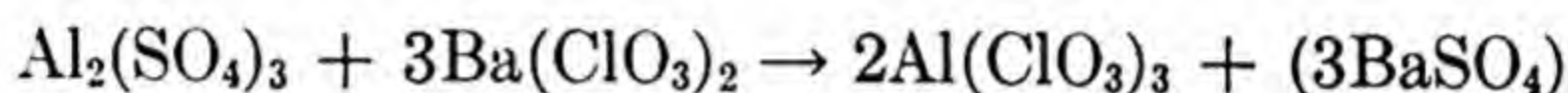
W. C. Ferguson, *J. Am. Chem. Soc.*, **16**, 154 (1894)

1



I-485

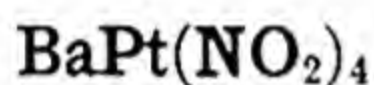
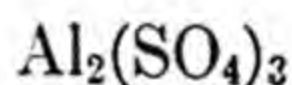
Aluminum chlorate is formed by the interaction of aluminum sulfate and barium chlorate.



Dobroserdoff, *J. Russ. Phys. Chem. Soc.*, **36**, 468 (1904)

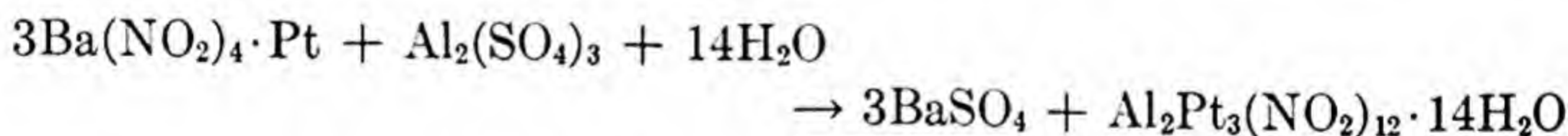
Ref., *J. Chem. Soc. (London)*, **86**, 564 (1904)

25



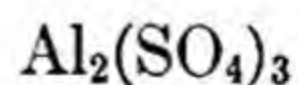
I-486

When solutions of barium platino-nitrite and aluminum sulfate are mixed and the barium sulfate filtered off, the filtrate yields on evaporation under reduced pressure and over sulfuric acid, large, colorless or pale yellow, cubical crystals of hydrated aluminum platino-nitrite. Similar methods yield somewhat similar salts of Cr, Fe⁺⁺⁺, In, Y, Er, Ce, La, and Nd.



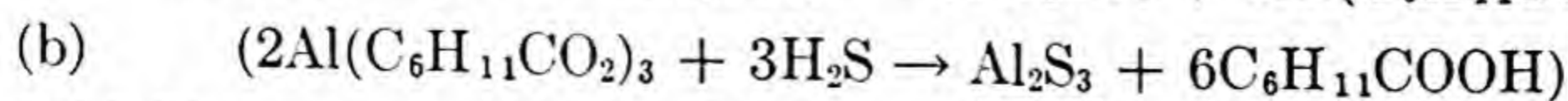
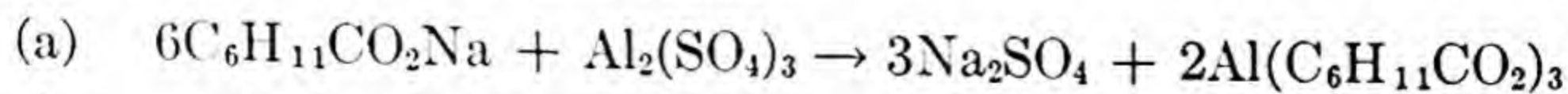
L. F. Nilson, *K. Sv. Vet. Ak. Handl. Öfvers.*, **33**, No. 7, 28-30 (1876)

10



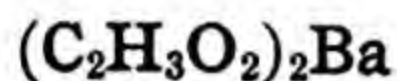
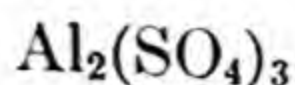
I-487

22.76 g. naphthenic acid neutralized by 4.2 g. NaOH in 30 cc water is treated with 14.5 g. $\text{Al}_2(\text{SO}_4)_3$ in 190 cc H_2O . Aluminum naphthenate is removed, dried, and dissolved in ligroin (sp. gr., 0.72). The solution is refluxed and treated with H_2S for 2 hrs. to yield a dark brown precipitate of aluminum sulfide.



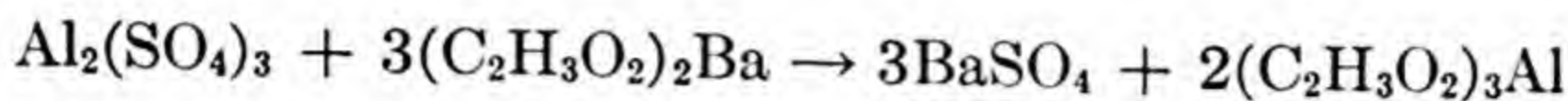
S. M. Weller, *J. Gen. Chem. (USSR)*, **7**, 1819 (1937)

60



I-488

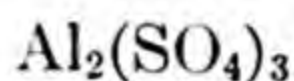
Barium sulfate precipitates when concentrated solutions of aluminum sulfate and barium acetate are mixed, after shaking, stirring and diluting with water.



Sacher, Chem. Zeit, **35**, 1447 (1911)

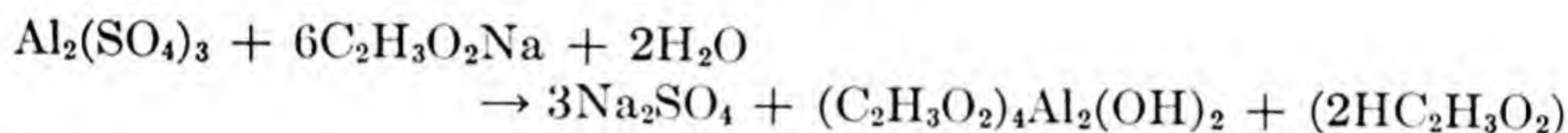
Ref., J. Chem. Soc. (London), **102**, 161 (1912)

25



I-489

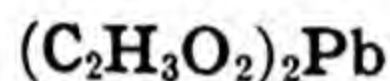
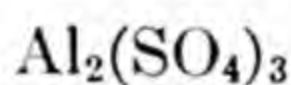
A basic aluminum acetate forms when concentrated solutions of aluminum sulfate and sodium acetate react.



G. Athenstadt, D. R. P. 23444

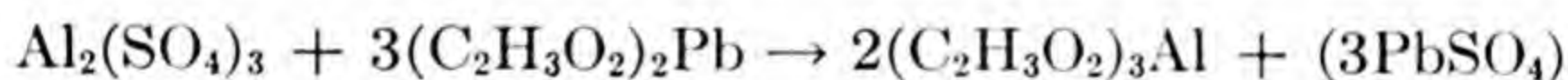
Ref., Ber., **16**, 2327 (1883)

25



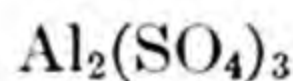
I-490

Aluminum acetate is formed when concentrated solutions of lead acetate and aluminum sulfate are mixed.



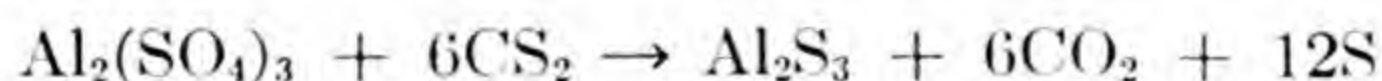
Walter Crum, Ann., **89**, 158 (1854)

25



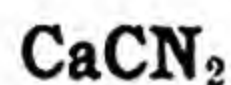
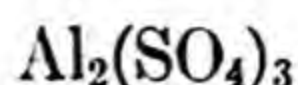
I-491

Anhydrous aluminum sulfate is heated in a retort to dark red, then carbon disulfide led in. After cooling, the sulfur is separated from the resulting aluminum sulfide.



D. A. Peniakoff, Germ. Pat. 79781, Z. angew. Chem., **8**, 111 (1895)

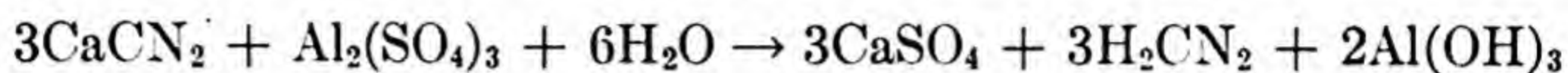
34



I-492

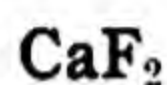
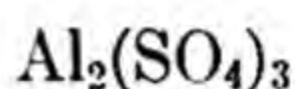


Calcium cyanamide reacts with a solution of aluminum sulfate.



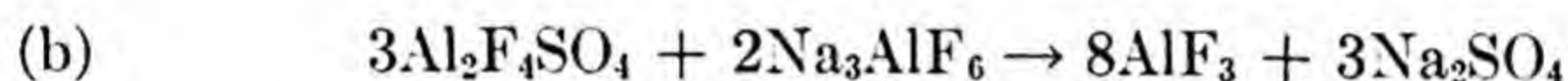
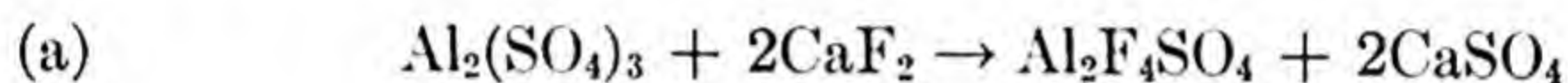
Caro, et al., Z. Angew. Chem., **23**, 2405 (1910)

25



I-493

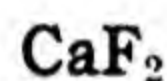
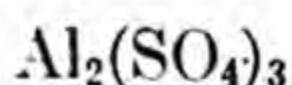
Aluminum fluoride is formed when aluminum sulfate is warmed with calcium fluoride, and the resulting solution treated with cryolite.



L. Grabau, D. R. P. 48535

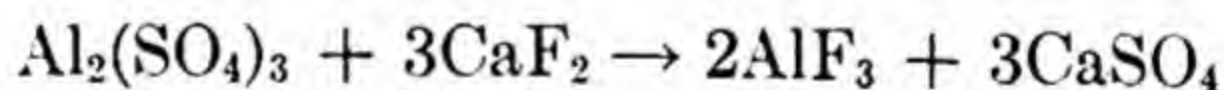
Ref., Ber., **22**, 781 (1889)

25



I-494

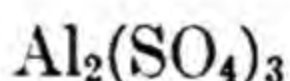
An aqueous solution of aluminum sulfate undergoes double decomposition with calcium fluoride.



Ch. Friedel,

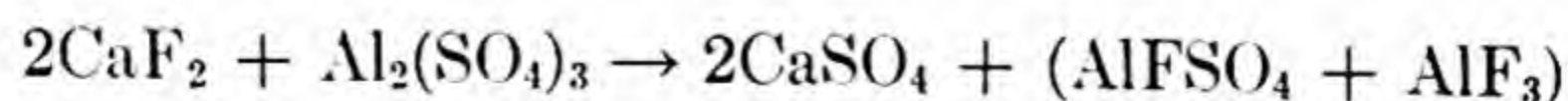
Ref., A. Henninger, Ber., **7**, 265 (1874)

11



I-495

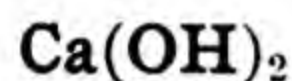
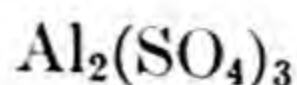
Fluorspar is attacked by a solution of aluminum sulfate forming calcium sulfate and aluminum fluosulfate.



Friedel,

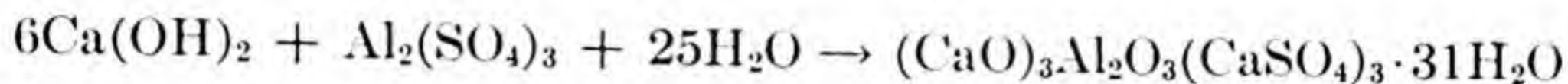
Ref., A. Henninger, Ber., **7**, 1446 (1874)

25



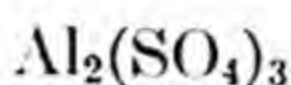
I-496

Interaction of aluminum sulfate and saturated lime water gives first a flocculent precipitate characteristic of aluminum hydroxide. This slowly changes to crystals and after standing six months a microscopic examination showed the crystals to be almost entirely calcium sulfoaluminate.



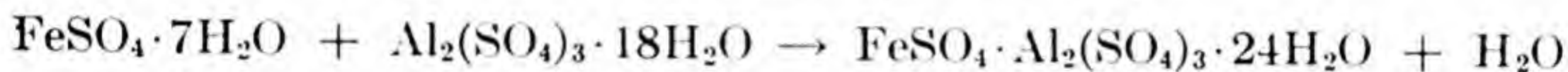
Lerch, Ashton and Bogue, B. S. J. Res., **2**, 271 (1929)

9



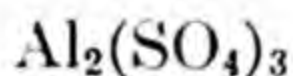
I-497

Mix saturated solutions of ferrous sulfate and aluminum sulfate, hang a silk bag containing a mixture of these salts in powder form into the solution and shake until the solution nearly "freezes". Take the bag out, add a few drops of water and recrystallize. This double salt cannot be made from the two saturated solutions only.



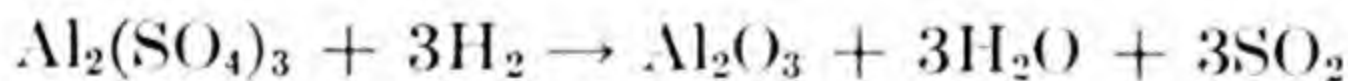
F. Wirth, Z. angew. Chem., **26**, 81 (1913)

34



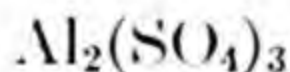
I-498

Aluminum oxide is formed when aluminum sulfate is heated to a high temperature with hydrogen.



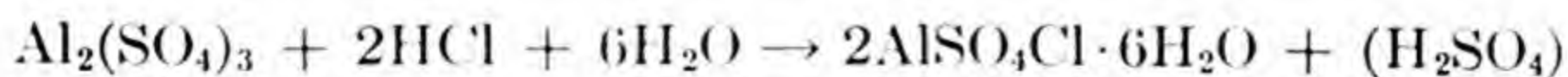
Otto Schumann, Ann., **187**, 305 (1877)

25



I-499

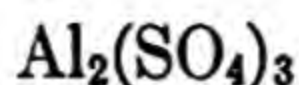
Aluminum chlorosulfate is formed when aluminum sulfate solution is treated with concentrated hydrochloric acid.



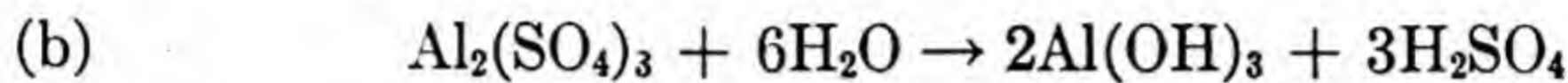
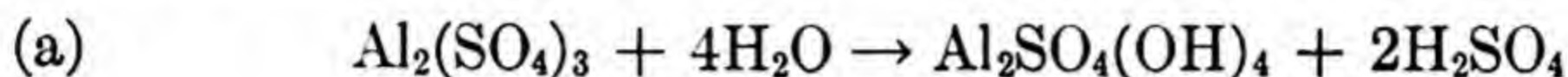
Recoura, Compt. rend., **135**, 736 (1902)

Ref., J. McCrae, J. Chem. Soc., **84**, 79 (1903)

25

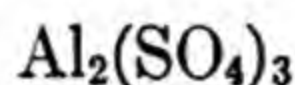
**H₂O****I-500**

Aluminum sulfate hydrolyzes with water giving first a basic aluminum sulfate and finally aluminum hydroxide. Sulfuric acid is the other product; therefore the solution is acid.



C. Kullgren, Sv. Kem. Tidskr., **13**, 111 (1901)

10

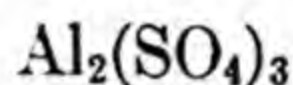
**H₂O****I-501**

In molar volumes from 4 to 64 the following hydrolysis reaction takes place at 25°.

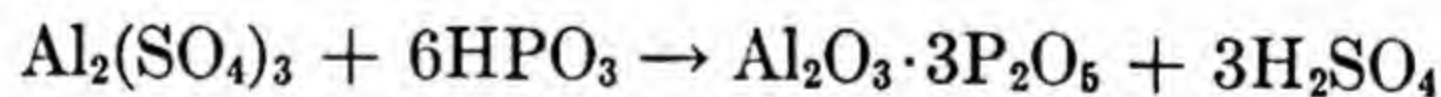


H. G. Denham, J. Chem. Soc. (London), **93**, 58 (1908)

57

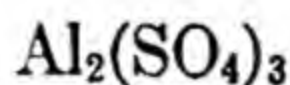
**HPO₃****I-502**

Aluminum metaphosphate is formed when dry aluminum sulfate is dropped into metaphosphoric acid which has been heated to redness in a platinum dish.

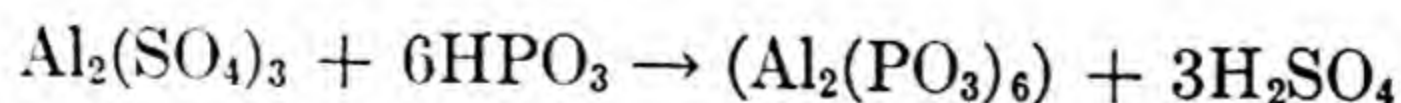


Madrell, Ann., **61**, 53 (1847)

1

**HPO₃****I-503**

Aluminum sulfate dissolves in metaphosphoric acid. Upon drying sulfuric acid fumes go off; the anhydrous aluminum metaphosphate separates with difficulty as a fine-grained, white powder consisting of very small, not well-formed crystals.

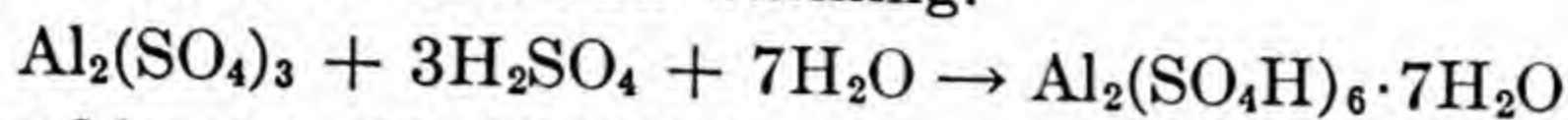


K. R. Johnson, K. Sv. Vet. Ak. Handl. Bihang., **14**, II, No. 1, 9 (1888)

10

H₂SO₄**Al₂(SO₄)₃****I-504**

Acid aluminum sulfate is prepared by adding aluminum sulfate to cold concentrated sulfuric acid and warming.



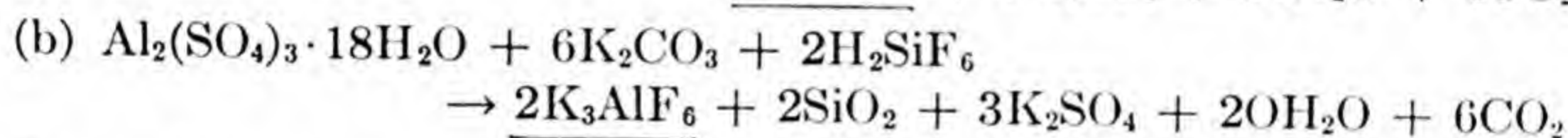
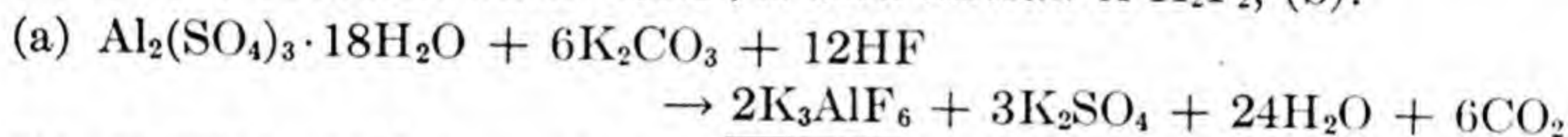
Silberberger, *Monatsh.*, **25**, 220 (1904)

Ref., *J. Chem. Soc. (London)*, **86**, 342 (1904)

25

Al₂(SO₄)₃**K₂CO₃****I-505****H₂F₂**

The large scale production of potassium hexafluoroaluminate is accomplished by dissolving aluminum sulfate in water, adding potassium carbonate and commercial hydrofluoric acid. The reacting mixture is held at the boiling point for 20–30 minutes. The gelatinous precipitate is dried to a fine white powder, giving as high as 90% yield, (a). Similar results are obtained when H₂SiF₆ is used instead of H₂F₂, (b).

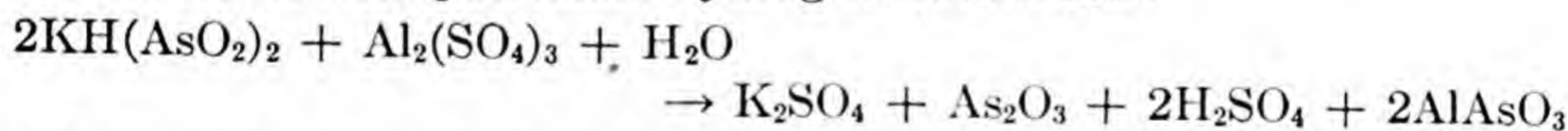


Carter, *Ind. Eng. Chem.*, **22**, 889 (1930)

24

Al₂(SO₄)₃**KH(AsO₂)₂****I-506**

An aluminum arsenite forms when a saturated solution of aluminum sulfate reacts with potassium hydrogen metarsenite.

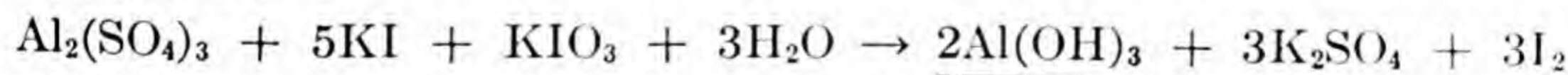


Reichard, *Ber.*, **27**, 1019 (1894)

25

Al₂(SO₄)₃**KI + KIO₃****I-507**

Aluminum sulfate reacts with potassium iodide and iodate, liberating free iodine.

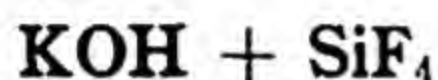
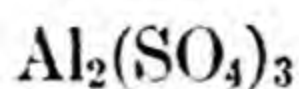


Glasmann, *J. Russ. Phys. Chem. Geo.*, **36**, 314

Ref., *Stock, Compt. rend.*, **130**, 175 (1914)

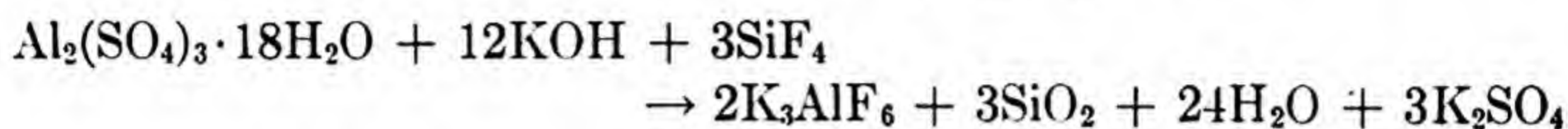
Ref., *J. Am. Chem. Soc.*, **27**, 1358 (1905)

1



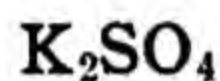
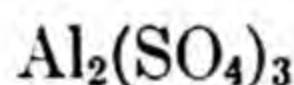
I-508

When potassium hexafluoroaluminate is prepared by reacting aluminum sulfate with potassium hydroxide and silicon tetrafluoride, the ratio of silica and aluminate is 3:2 making a very light powder.



Carter, Ind. Eng. Chem., **22**, 889 (1930)

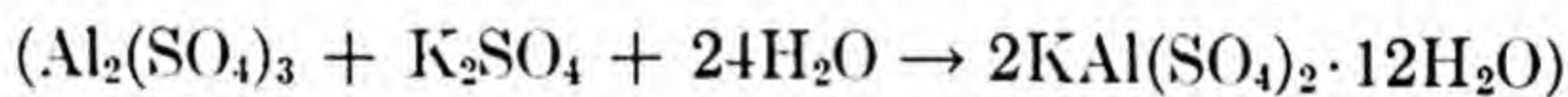
24



I-509

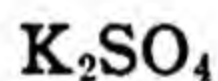
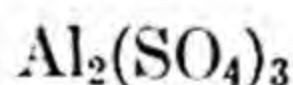
When saturated solutions of aluminum sulfate and potassium sulfate are mixed in varying proportions at 25°, a solid phase, partly consisting of crystalline alum separates out.

The quantity of alum formed varies with the relative concentrations of the reagents and with the temperature.



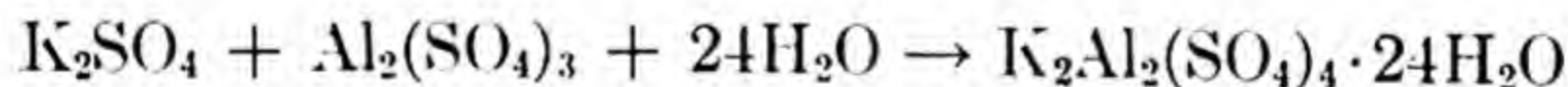
Hubert T. S. Britton, J. Chem. Soc., **121**, 983 (1922)

48



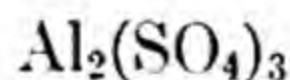
I-510

A solution of aluminum sulfate was mixed with a solution of potassium sulfate and the mixture allowed to evaporate. Alum was formed.



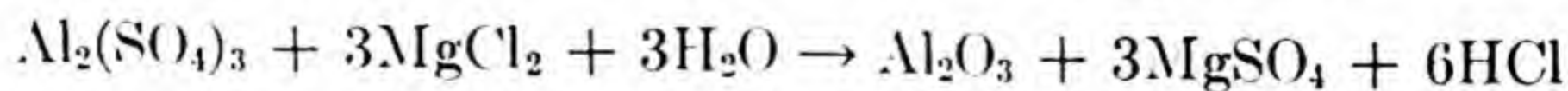
Charles Hatchett, Trans. Roy. Soc. (London), **88**, 117 (1898)

105



I-511

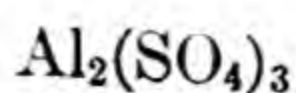
Aluminum oxide and magnesium sulfate are formed when a solution of magnesium chloride and aluminum sulfate is evaporated.



G. Rosenthal, D. R. P. 31357

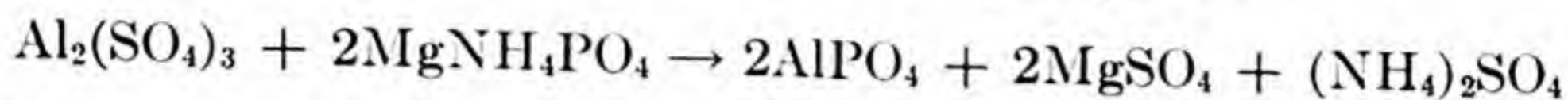
Ref., Ber., **18**, 350 (1885)

25



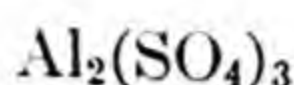
I-512

Aluminum phosphate is formed when aluminum sulfate is boiled with an excess of moist magnesium ammonium phosphate.



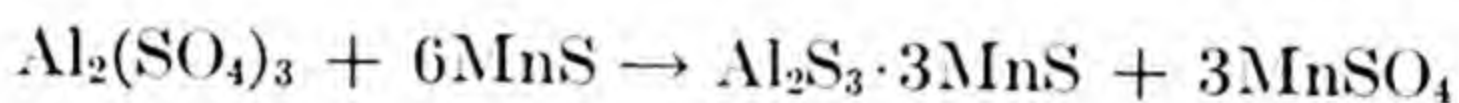
E. Erlenmeyer and G. Lewinstein, *Jahresber. d. Chemie* (1860), p. 638
 Ref., *Z. anal. Chem.*, **29**, 73 (1890)

25



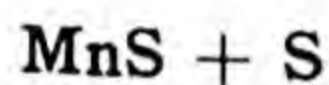
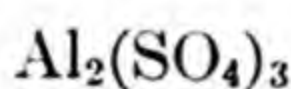
I-513

A double sulfide is obtained when aluminum sulfate and manganous sulfide are heated together in as dry conditions as possible.



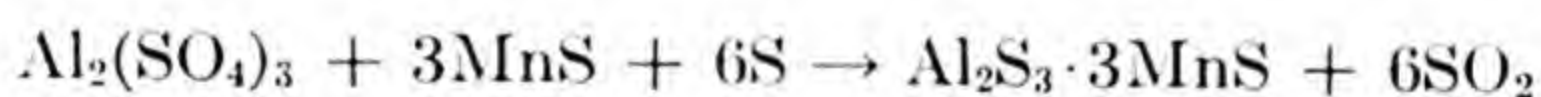
Peniakoff, D. R. P. 86523 (1893)
 Ref., *Ber.*, **29**, 447 (1896)

25



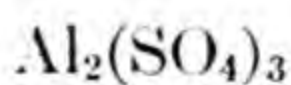
I-514

A double sulfide is obtained when aluminum sulfate and manganous sulfide are heated together in the presence of sulfur in as dry conditions as possible.



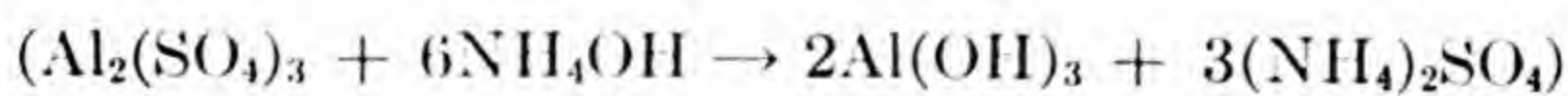
Peniakoff, D. R. P. 86523 (1893)
 Ref., *Ber.*, **29**, 447 (1896)

25



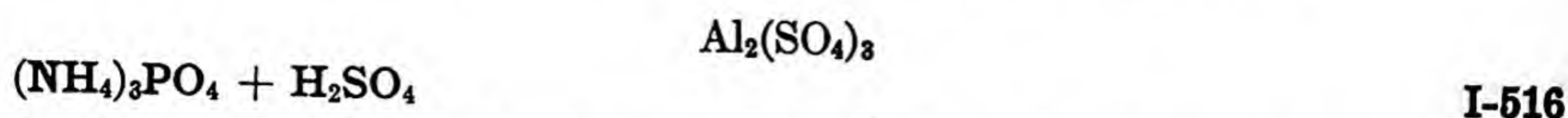
I-515

Aluminum hydroxide can be prepared by the action of ammonium hydroxide on a solution of pure aluminum sulfate.

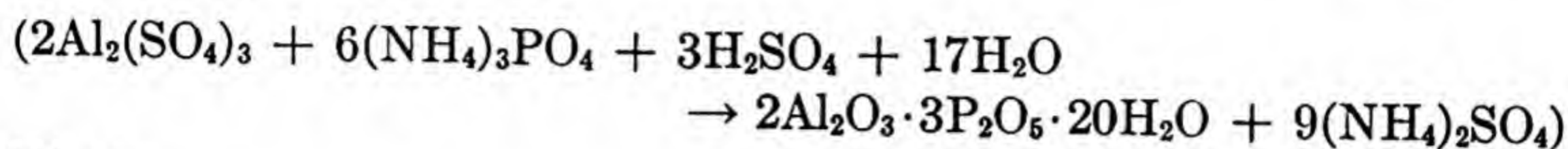


Shanti, S. Bhatnagar, *J. Chem. Soc. (London)*, **119**, 1762 (1921)

48



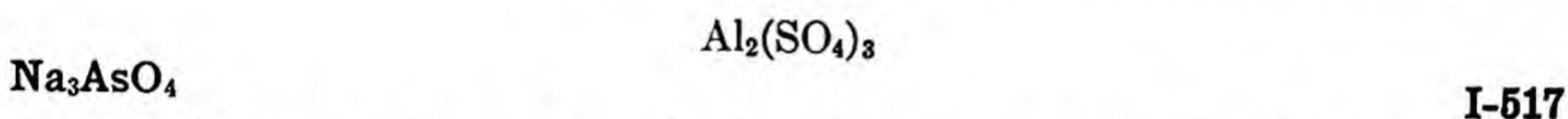
When 6 moles of aluminum sulfate are heated with 2 moles of ammonium phosphate and some sulfuric acid, an acid aluminum phosphate is formed.



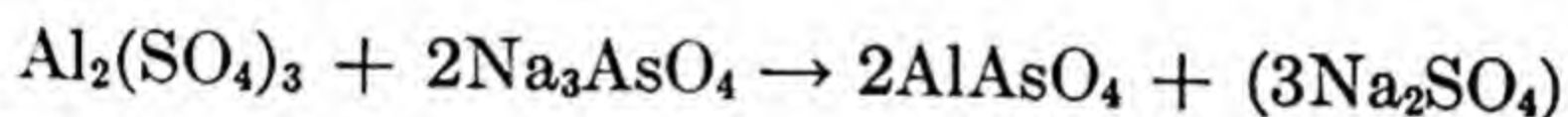
Minot,

Ref.: A. Henninger, Ber., **67**, 1447 (1874)

11



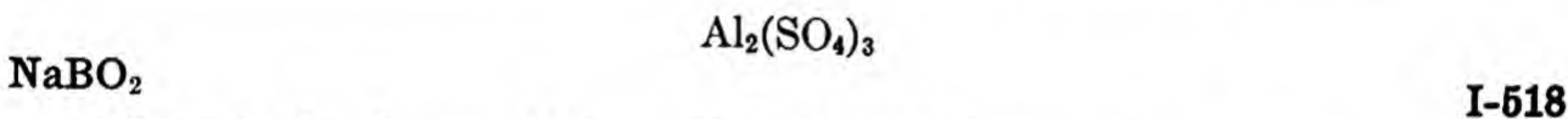
Aluminum arsenate is formed when aluminum sulfate reacts with sodium arsenate at 200°C.



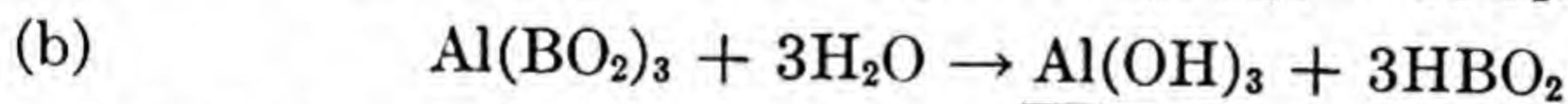
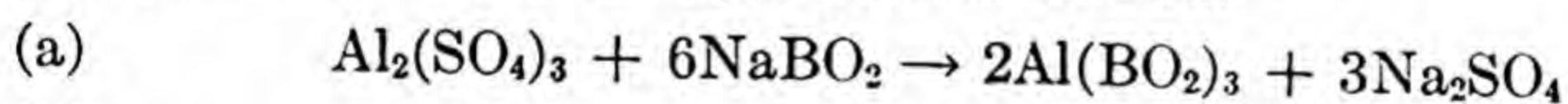
Coloriano, Compt. rend., **103**, 273

Ref., Ber., **19**, 660 (1886)

25

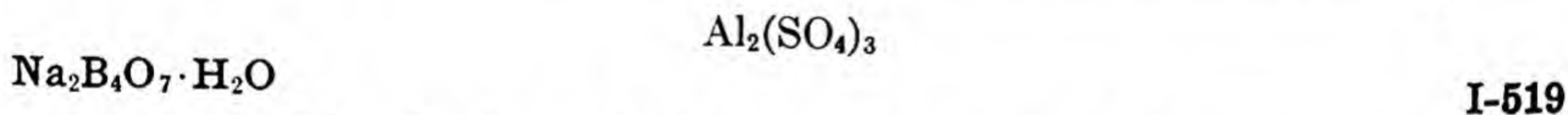


When an aluminum sulfate solution is treated with sodium metaborate a precipitate of aluminum hydroxide is formed.

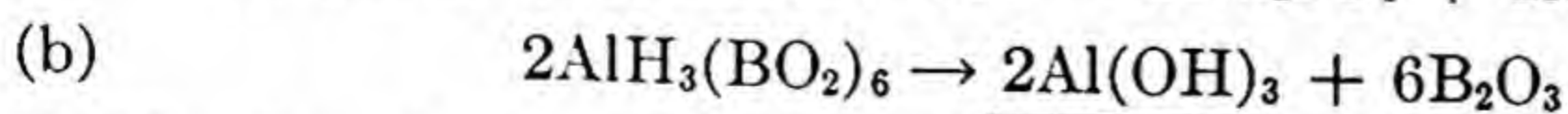
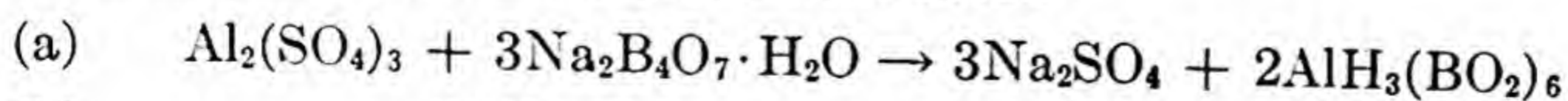


Carl Jehn, Ber., **7**, 675 (1874)

11



An unstable aluminum hydrometaborate, which decomposes into aluminum hydroxide and boron oxide, is precipitated when a solution of aluminum sulfate is treated with borax.

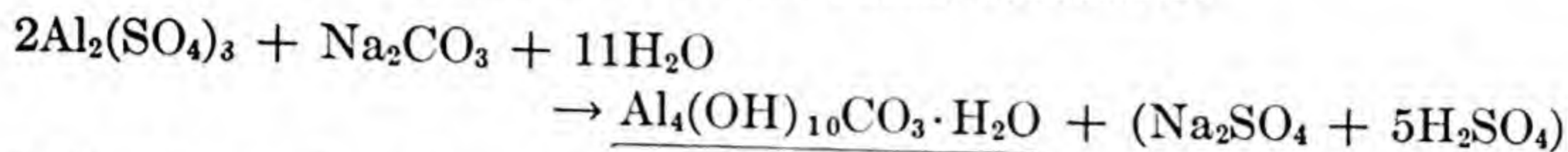


C. Jehn, Ber., **7**, 675 (1874)

25

Na₂CO₃Al₂(SO₄)₃**I-520**

A basic aluminum carbonate is formed when a solution of aluminum sulfate is treated with a solution of sodium carbonate.

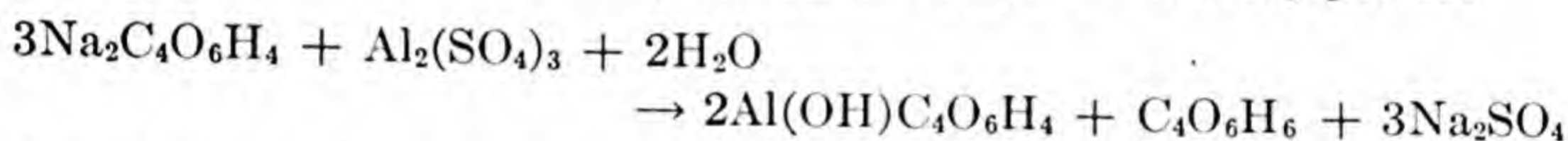


Schlumberger, Bull. Soc. Chim. (3), **13**, 41-65
Ref., Ber., **28**, 901 (1895)

25

Na₂C₄O₆H₄Al₂(SO₄)₃**I-521**

An addition compound is formed in solutions of aluminum sulfate and disodium tartrate as shown by the curve of optical rotatory power:

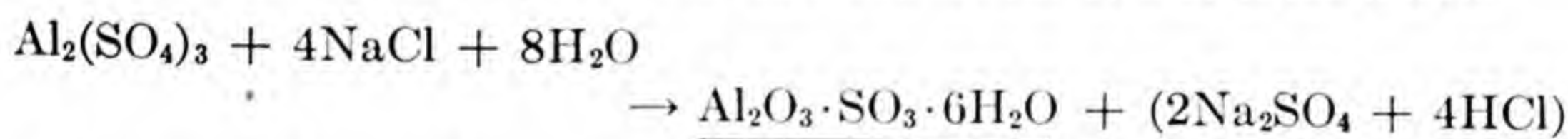


J. L. Delsal, J. Chim. phys., **35**, 350 (1938)

69

NaClAl₂(SO₄)₃**I-522**

A heavy white powder separates when aluminum sulfate, sodium chloride and water are heated at 130-140°C. for two or three hours.

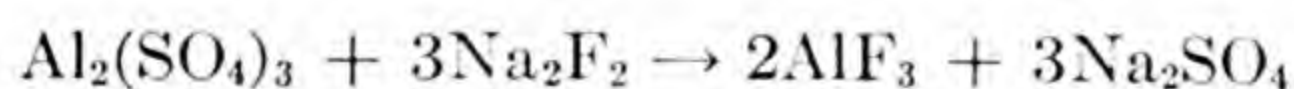


C. Bottinger, Ann., **244**, 224-227 (1888)
Ref., Ber., **21**, 280 (1888)

25

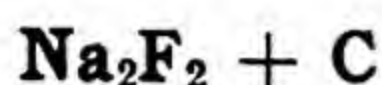
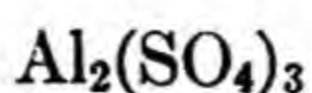
Na₂F₂Al₂(SO₄)₃**I-523**

Aluminum fluoride forms when aluminum sulfate is added to sodium fluoride.



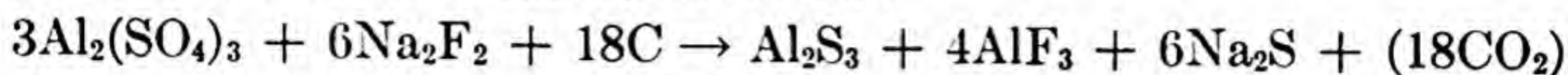
Peniakoff, D. R. P. 89143
Ref., Ber., **29**, 1021 (1896)

25



I-524

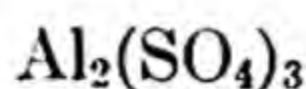
Aluminum sulfide is prepared when a mixture of aluminum sulfate, sodium fluoride and carbon is heated.



Gruy, Z. angew. Chem., 290 (1894)

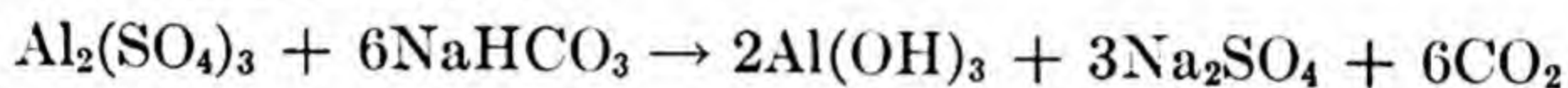
Ref., Ber., 27, 498 (1894) (abstr.)

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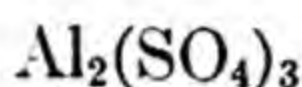
I-525

Two foam producing solutions, sodium hydrogen carbonate and aluminum sulfate, react with each other to form aluminum hydroxide, sodium sulfate and carbon dioxide.



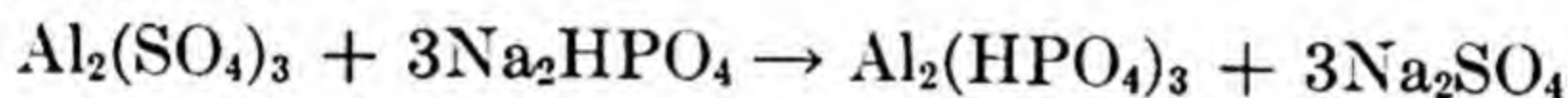
C. K. Swift, Ind. Eng. Chem., 16, 590 (1924)

23



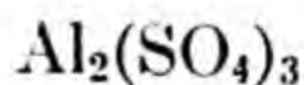
I-526

Aluminum hydrogen phosphate is formed when a solution of aluminum sulfate is titrated with N/10 disodium hydrogen orthophosphate in the presence of methyl red.



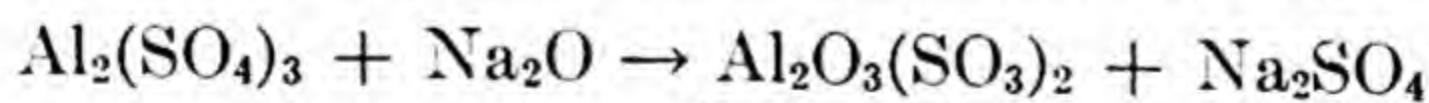
Gellinek and Kuhn, Z. anorg. Chem., 138, 124 (1924)

25



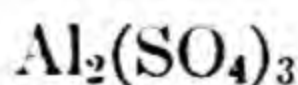
I-527

Basic aluminum sulfite is precipitated when caustic soda or sodium oxide is added to a boiling solution of aluminum sulfate.



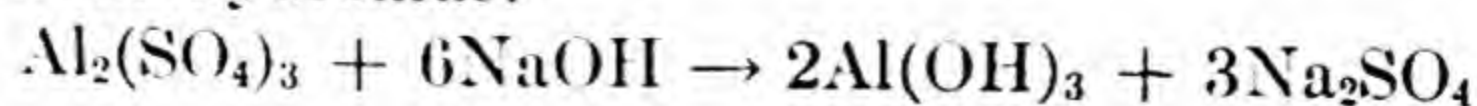
W. C. Ferguson, J. Am. Chem. Soc., 16, 154 (1894)

1



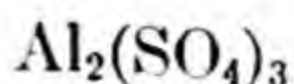
I-528

Sodium hydroxide solution added to aluminum sulfate solution precipitates aluminum hydroxide.

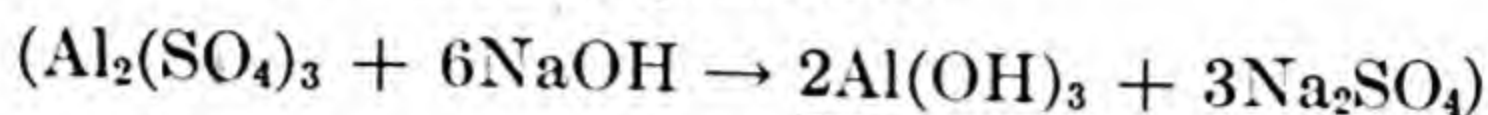


J. K. Wood, J. Chem. Soc., (London), 93, 421 (1908)

57

NaOH**I-529**

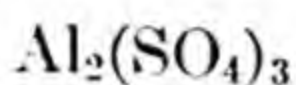
Solutions of aluminum sulfate can be titrated with sodium hydroxide at 100°, with phenolphthalein as indicator. Aluminum hydroxide and sodium sulfate are the reaction products.



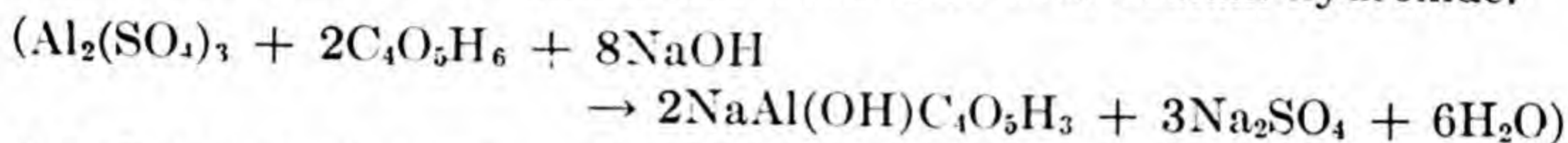
Schmatolla, Ber., **38**, 987 (1905)

Ref., Hubert T. S. Britton, J. Chem. Soc., **121**: **1**, 983 (1922)

48

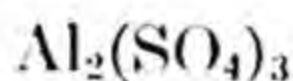
NaOH + C₄O₅H₆**I-530**

An active complex is formed in the neutralization of an equimolecular solution of aluminum sulfate and malic acid with sodium hydroxide.

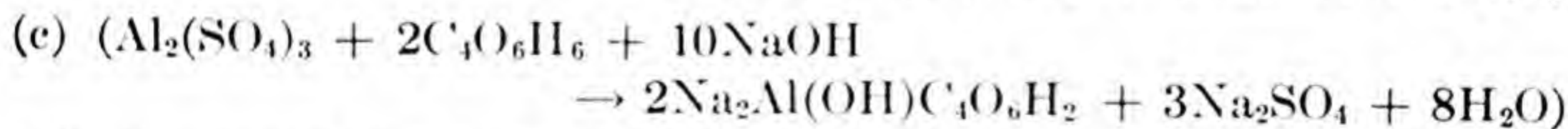
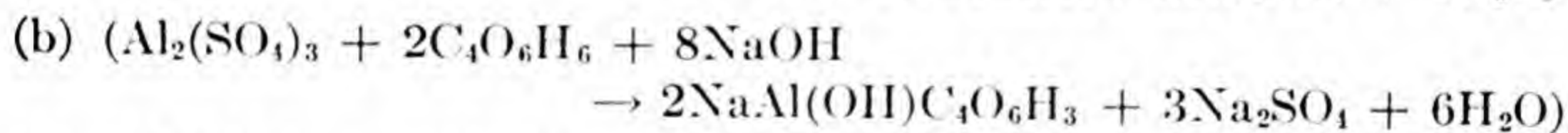
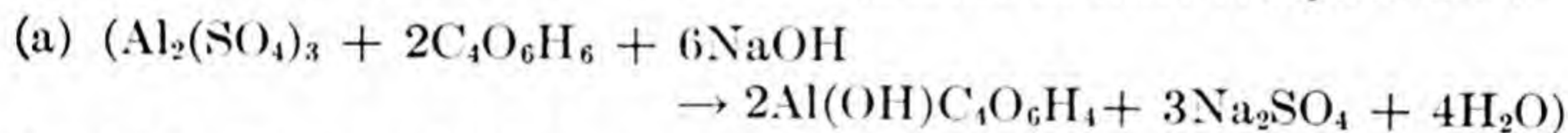


J. L. Delsal, J. Chim. phys., **35**, 350 (1938)

69

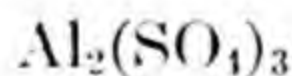
NaOH + C₄O₆H₆**I-531**

The neutralization curve of solutions of aluminum sulfate and tartaric acid by sodium hydroxide shows the existence of three complex salts.

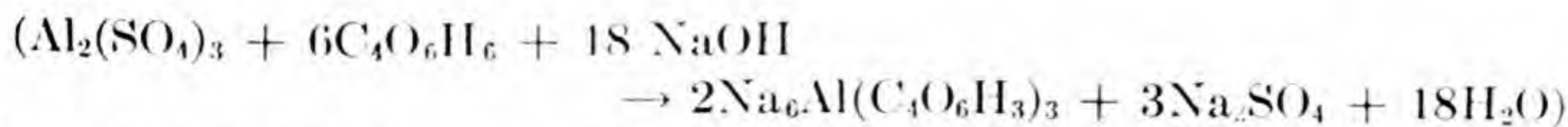


J. L. Delsal, J. Chim. phys., **36**, 350 (1938)

69

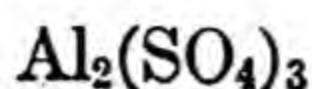
NaOH + C₄O₆H₆**I-532**

A complex compound is formed in solution when a mixture of 1 mole of aluminum sulfate and 6 moles of tartaric acid is neutralized by sodium or potassium hydroxide.

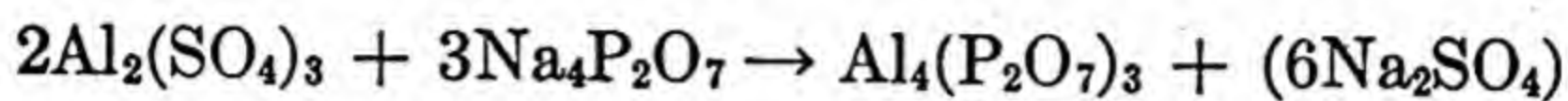


J. L. Delsal, J. Chim. phys., **35**, 350 (1938)

69

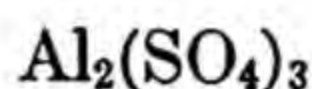
Na₄P₂O₇**I-533**

When solutions of aluminum sulfate and of sodium pyrophosphate are mixed, there precipitates a slimy mass of aluminum pyrophosphate.

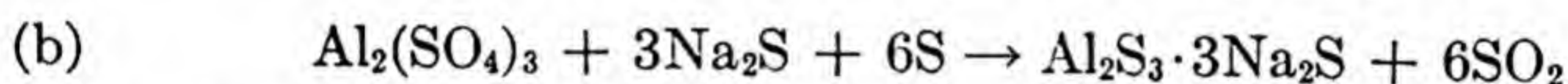
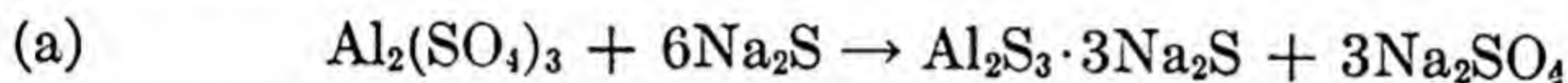


C. N. Pahl, K. Sv. Vet. Akad. Handl. Öfvers., **30**, No. 7, 31 (1873)

10

Na₂S**I-534**

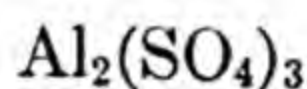
A double sulfide is obtained when aluminum sulfate is heated with an alkaline sulfide in water-free conditions. When sulfur is added to the above mixture the reaction is shown in (b).



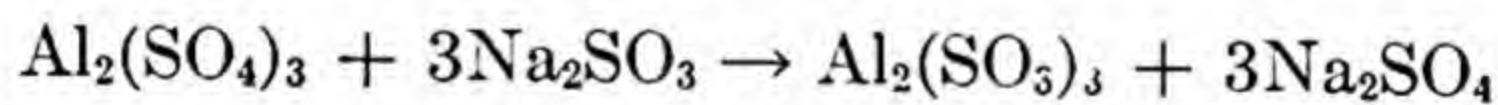
Peniakoff, D. R. P. 86523 (1893)

Ref., Ber., **29**, 447 (1896)

25

Na₂SO₃**I-535**

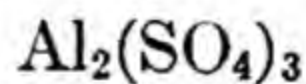
Aluminum sulfite remains in solution if a mixture containing molecular proportions of aluminum sulfate and sodium sulfite (finely powdered) is treated with a little water and cooled.



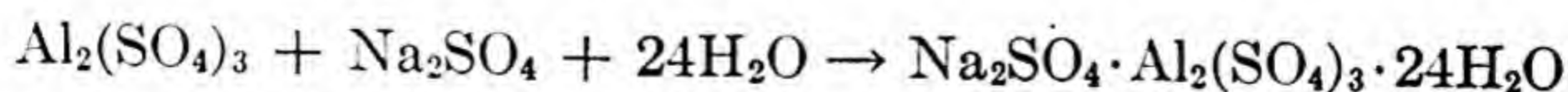
G. Manzoni, Gazz. chim. ital., **14**, 360

Ref., Ber., **18**, 99 (1885)

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Na₂SO₄**I-536**

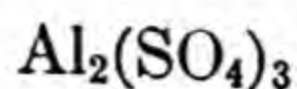
Sodium alum is formed when neutral solutions of sodium and aluminum sulfates are mixed and the solution concentrated to specific gravity 1.38–1.42 and allowed to cool.



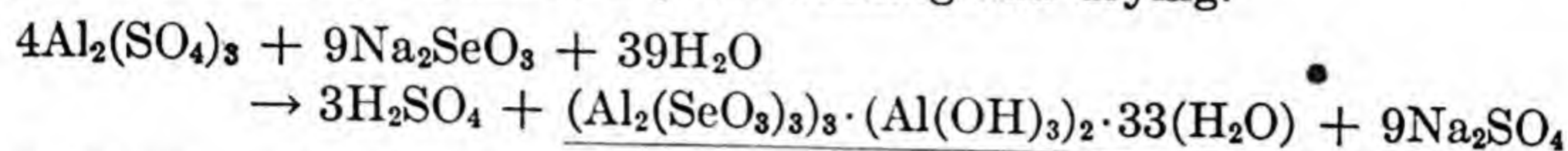
Dumont, (D. R. P. 141670)

Ref., J. Chem. Soc. (London), **84**, 547 (1903)

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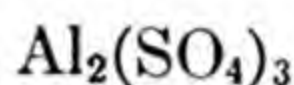
Na₂SeO₃**I-537**

When an excess of aluminum sulfate is precipitated with sodium selenite the basic aluminum selenite forms as an amorphous, very voluminous powder which becomes heavy on washing and drying.

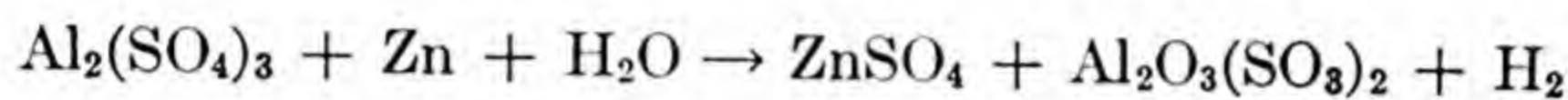


L. F. Nilson, *Nova Act. Reg. Soc. Sci. Upsal.* [3], **9**, No. 7, 78 (1874)

10

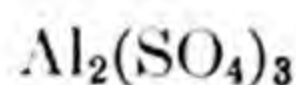
Zn**I-538**

Basic aluminum sulfate is precipitated when a solution of the normal sulfate is treated with zinc.

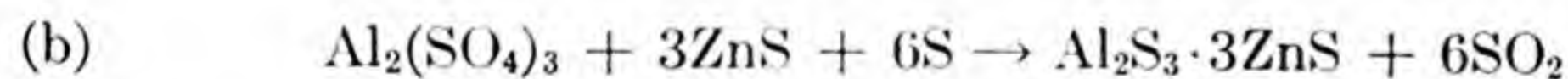
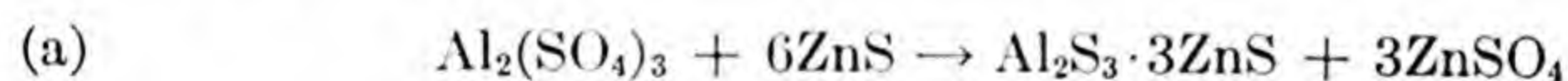


W. C. Ferguson, *J. Am. Chem. Soc.*, **16**, 154 (1894)

1

ZnS**I-539**

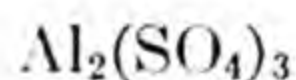
Aluminum zinc sulfide is obtained when aluminum sulfate and zinc sulfide are heated together in as dry conditions as possible, (a). When the above mixture is treated with extra sulfur before heating the reaction goes as shown in (b).



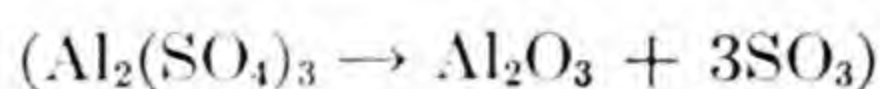
Peniakoff, D. R. P. 86523 (1893)

Ref., *Ber.*, **29**, 447 (1896)

25

Δ**I-540**

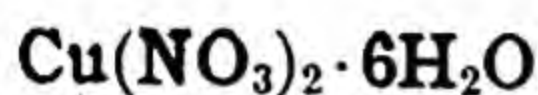
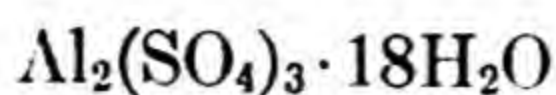
At 600–700°C. aluminum sulfate is decomposed into the oxide:



Friedrich and Blicke, *Metallurgie*, **7**, 323 (1910)

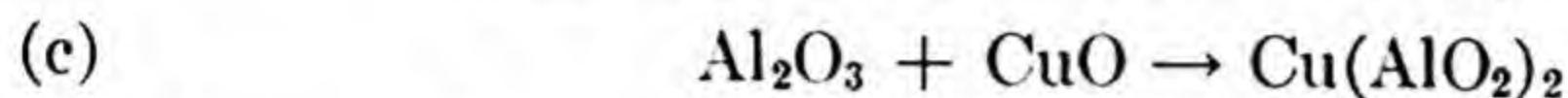
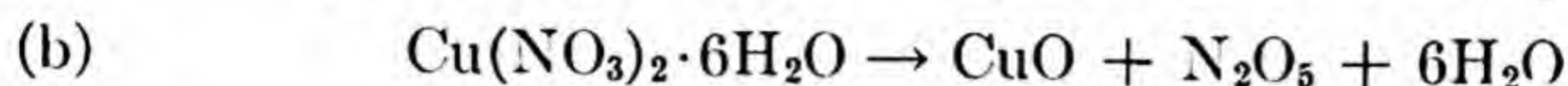
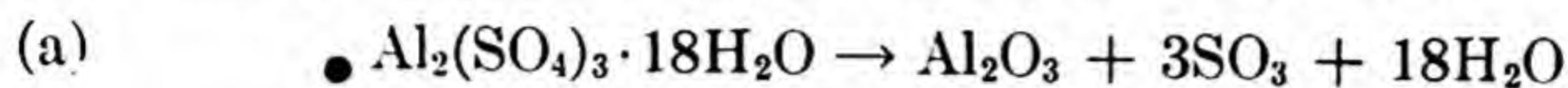
Ref., G. Marchal, *J. Chim. phys.*, **22**, 325 (1925)

69



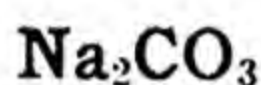
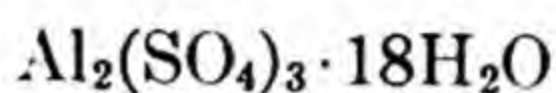
I-541

To a solution of aluminum sulfate a solution of cupric nitrate is added. Evaporate to dryness. By heating in a platinum crucible for 5 hours at a temperature of 950° cupric aluminate is obtained.



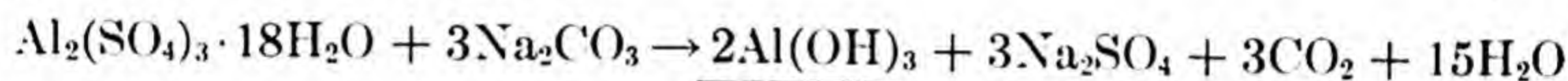
L. Holgersson, *Z. anorg. Chem.*, **204**, 378 (1932)

28



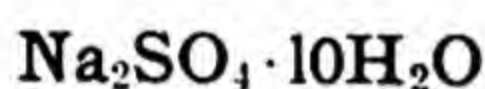
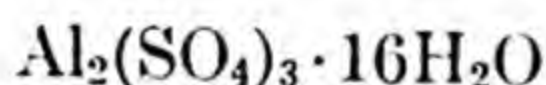
I-542

If a strong solution of aluminum sulfate is mixed with a strong solution of soda ash, the reaction product is a clear solution, which gives promise of being very useful in water clarification work. By using sodium hydroxide or bicarbonate, a similar solution is obtained. Sodium hydroxide requires a longer time for solution, however, while the bicarbonate effervesces excessively.

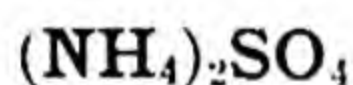


Joseph W. Cox, Jr., *Chem. Met. Eng.*, **29**, 279 (1923)

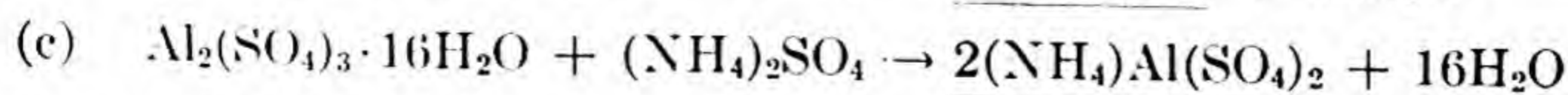
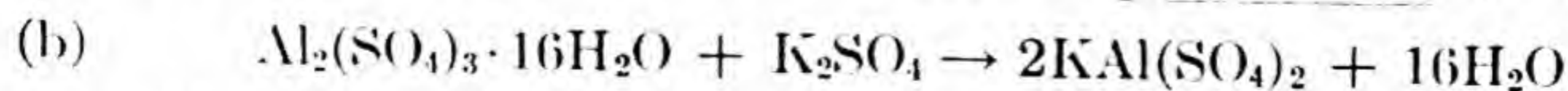
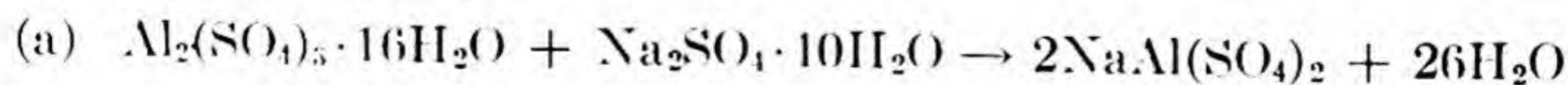
44



I-543

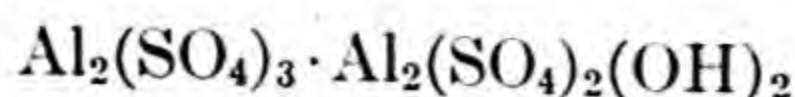


12 grams hydrated aluminum sulfate and 27 grams hydrated sodium sulfate are dissolved in 70 cc H_2O . 5 cc concentrated H_2SO_4 is added. This solution is concentrated by evaporation and 25 cc concentrated H_2SO_4 again added. The resulting solution is evaporated at a temperature of 200° , yielding crystals of sodium alum without water of crystallization. The same type reaction occurs with potassium sulfate and ammonium sulfate.

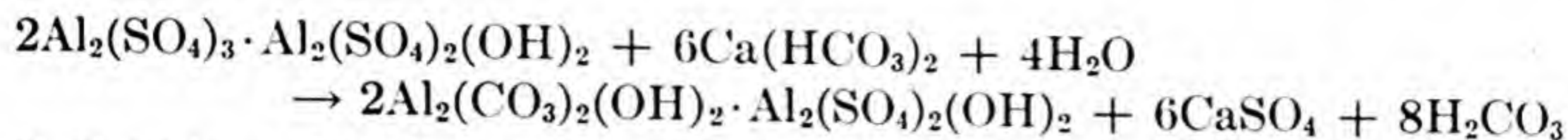


N. Schischkin, *Z. anorg. Chem.*, **189**, 289 (1930)

28

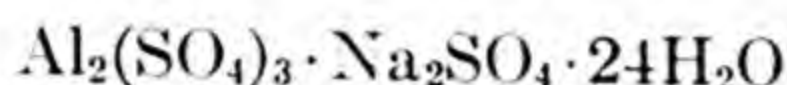
**Ca(HCO₃)₂****I-544**

When basic aluminum sulfate is added to water which is temporarily hard, the reaction is:

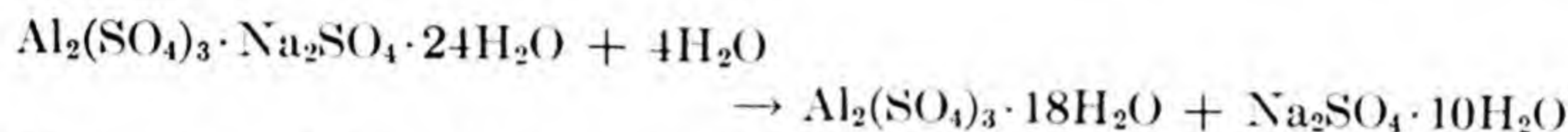


F. E. Hale, J. Ind. Eng. Chem., **6**, 633 (1914)

22

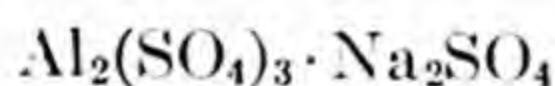
**H₂O****I-545**

Sodium alum decomposes in water solution according to the following equation:

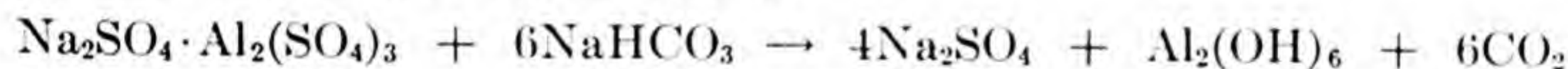


Mousseron and Gravier, Bull. Soc. Chim., [4] **51**, 1384 (1932)

31

**NaHCO₃****I-546**

Sodium aluminum sulfate and sodium bicarbonate react in baking powders to produce carbon dioxide.

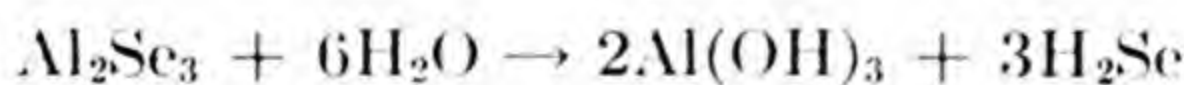


R. M. Ladd, Can. Chem. Met. Eng., **12**, 308 (1928)

15

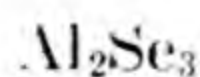
**H₂O****I-547**

Pure hydrogen selenide can be prepared by the hydrolysis of aluminum selenide.

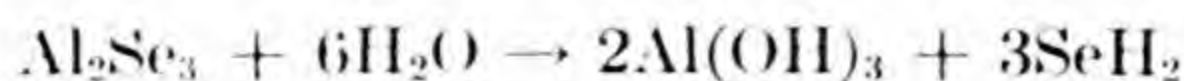


M. deHlasko, J. Chim. phys., **20**, 167 (1923)

69

**H₂O****I-548**

Aluminum selenide is decomposed readily by water.



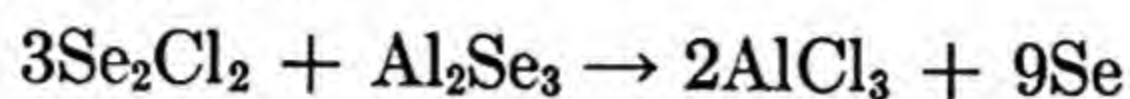
J. Papish, J. Phys. Chem., **22**, 642 (1918)

85



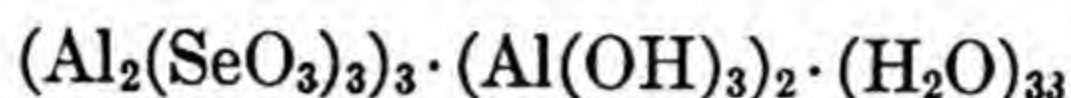
I-549

Aluminum selenide is converted into aluminum chloride and selenium by selenium monochloride.



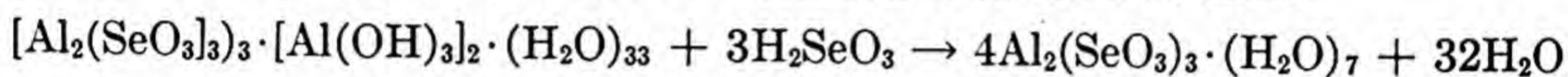
Lenher and Kao, J. Am. Chem. Soc., **48**, 1553 (1926)

1



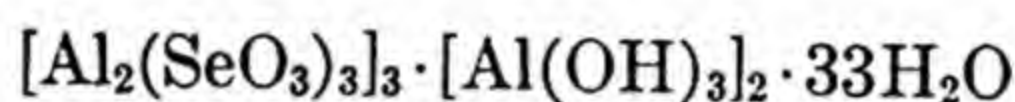
I-550

When the 3:2:33 basic aluminum selenite is digested with selenious acid the heptahydrated normal aluminum selenite is formed.



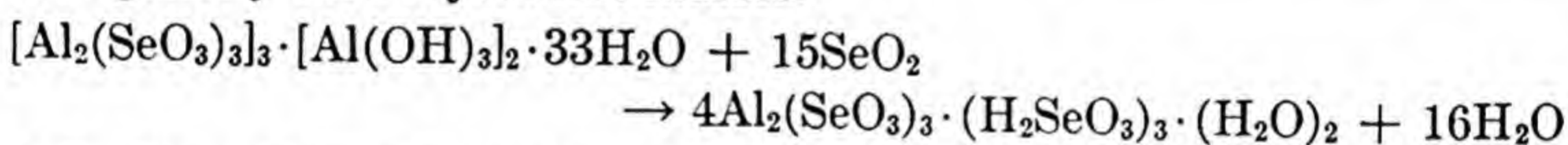
L. F. Nilson, Nova Act. Reg. Soc. Sci. Upsal. [3], Vol. **9**, No. 7, 79 (1874)

10



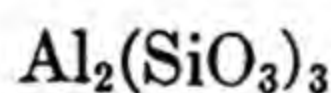
I-551

When the 3:2:33 basic aluminum selenite is digested with selenium dioxide the 1:3:2 hydrated aluminum hydrogen selenite is formed as first gummy then crystalline masses.



L. F. Nilson, Nova Act. Reg. Soc. Sci. Upsal. [3], Vol. **9**, No. 7, 80 (1874)

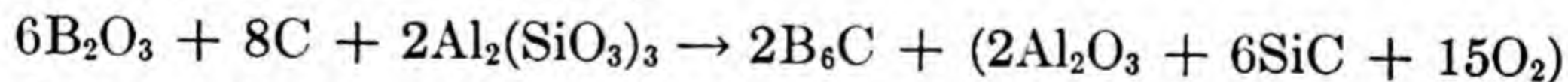
10



I-552

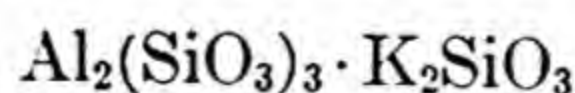


Boron carbide is formed when an arc is passed between carbon electrodes which are bound together with a mixture of boric oxide and alumino silicate (Method of Moissan).



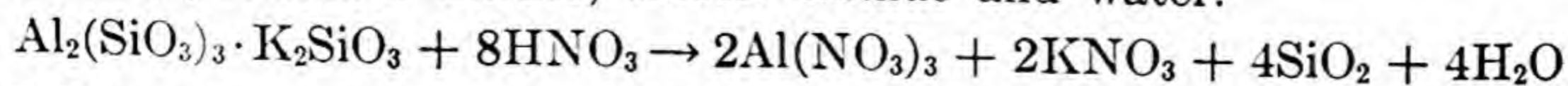
Tucker and Bliss, J. Am. Chem. Soc., **28**, 605 (1906)

1



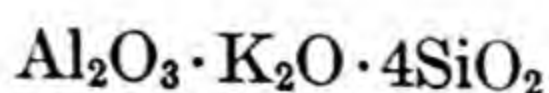
I-553

By treating Leucite with nitric acid the result will be aluminum nitrate, potassium nitrate, silicon dioxide and water.

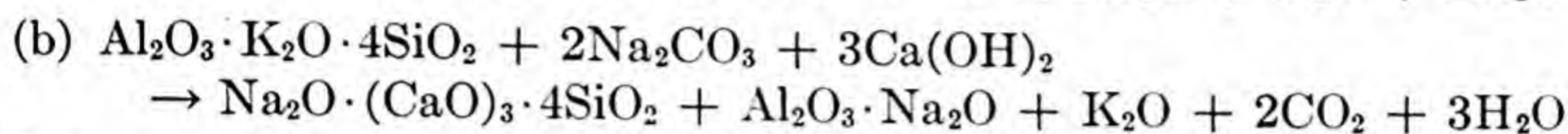
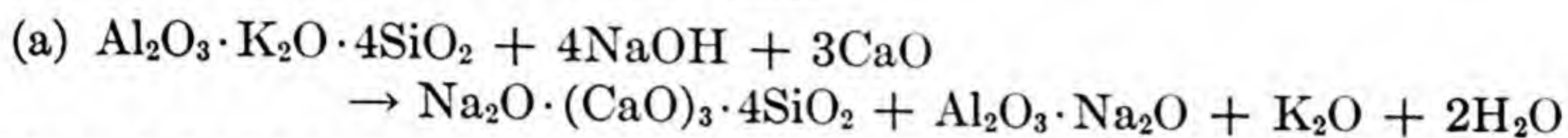


C. Manuelli, Gazz. Chim. Ital., **38** 151 (1908)

21

**NaOH + CaO****I-554**

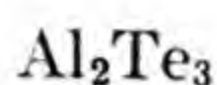
Leucite is decomposed by treatment with sodium hydroxide and quick lime or sodium carbonate and lime.



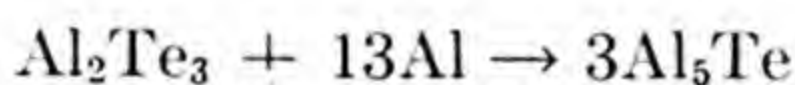
Lake, Brit. Pat. No. 17985

Ref., Cushman and Hubbard, J. Am. Chem. Soc., **30**, 794 (1908)

1

**Al****I-555**

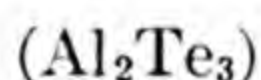
An aluminum telluride is formed when dialuminum tritelluride undergoes a transformation in the presence of aluminum at a temperature slightly below 551°.



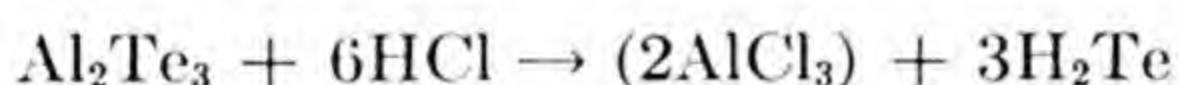
Chikashige and Nose, Mem. Coll. Sci. (Kyoto), **2**, 227 (1917)

Ref., J. Chem. Soc. (London), **114**, 114 (1918)

25

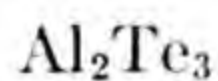
**HCl****I-556**

Hydrogen telluride is formed when aluminum telluride reacts with dilute hydrochloric acid.

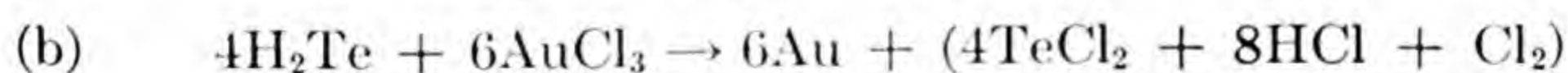
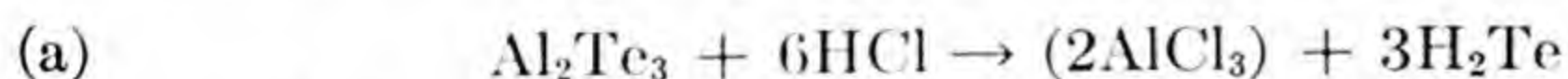


Dennis and Anderson, J. Am. Chem. Soc., **36**, 890 (1914)

1

**HCl****I-557****AuCl₃**

Hydrogen telluride, formed by the action of dilute hydrochloric acid on aluminum telluride, precipitates gold from auric chloride solution.

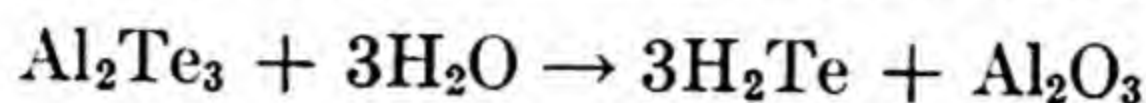


V. Lenher, J. Am. Chem. Soc., **24**, 358 (1902)

1

H₂O **Al₂Te₃** **I-558**

Aluminum telluride is energetically decomposed by water or moist air with the formation of hydrogen telluride and aluminum oxide.

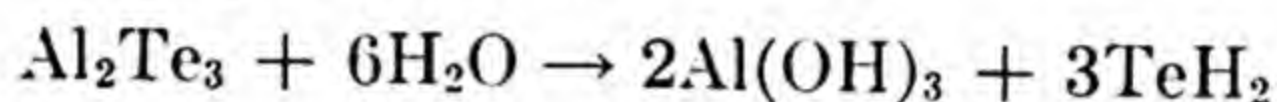


Chikashige and Nose, Mem. Coll. Sci. (Kyoto), **2**, 227 (1917)
Ref., J. Chem. Soc. (London), **114**, 114 (1918)

25

H₂O **Al₂Te₃** **I-559**

Aluminum telluride is decomposed readily by water yielding aluminum hydroxide and hydrogen telluride.

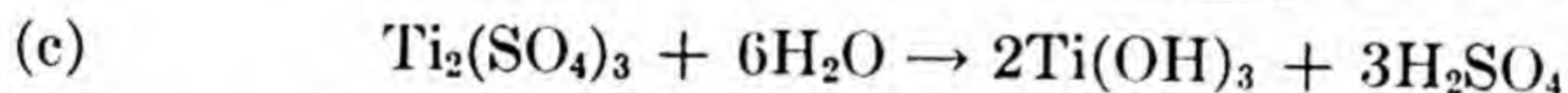
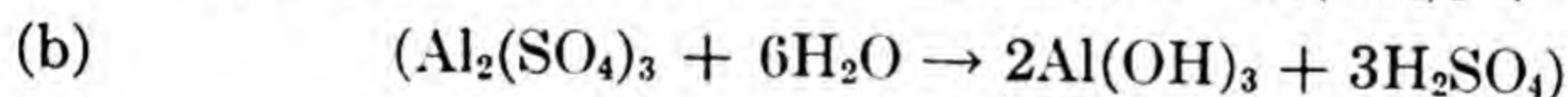
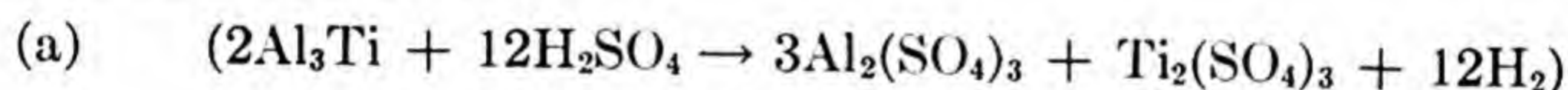


J. Papish, J. Phys. Chem., **22**, 643 (1918)

85

H₂SO₄ **Al₃Ti** **I-560**
H₂O

Aluminum hydroxide is formed when aluminum titanide is decomposed by dilute sulfuric acid.

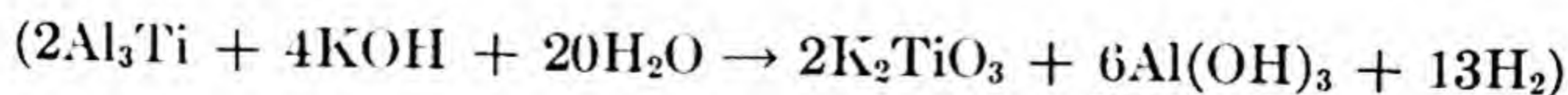


Manchot and Richter, Ann. **357**, 143 (1907)

25

KOH **Al₃Ti** **I-561**
H₂O

Aluminum hydroxide is formed along with the evolution of hydrogen when aluminum titanide is decomposed by strong potassium hydroxide solution.

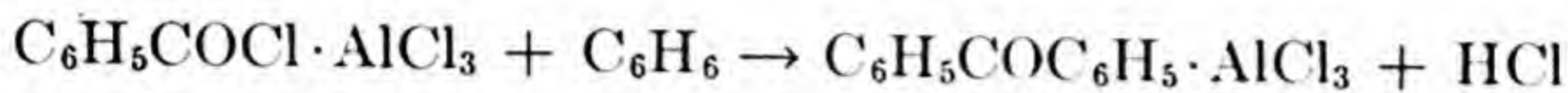


Manchot and Richter, Ann. **357**, 143 (1907)

25

**C₆H₆****I-562**

Benzene, added to a solution of benzoyl chloride-aluminum chloride in pure, dry carbon bisulfide, substitutes the chlorine of the benzoyl chloride to yield benzophenone-aluminum chloride, from which pure benzophenone may be obtained. This is known as the Friedel-Crafts reaction.

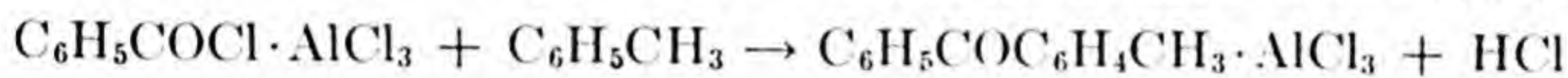


J. Boeseken, *Rec. trav. chim.*, **19**, 21 (1900)

27

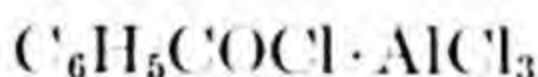
**C₆H₅CH₃****I-563**

The addition of toluene to a solution of benzoyl chloride-aluminum chloride in pure, dry carbon bisulfide results in the formation of methyl benzophenone-aluminum chloride. The compound crystallizes when the solvent and excess toluene are removed by evaporation under vacuum and the residue permitted to stand in the dark for several days.

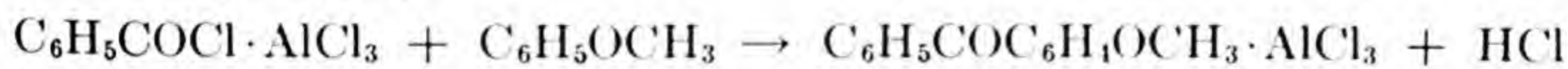


J. Boeseken, *Rec. trav. chim.*, **19**, 22 (1900)

27

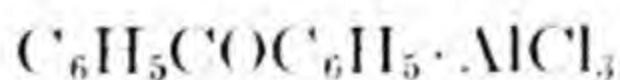
**C₆H₅OCH₃****I-564**

The addition of anisol to a solution of benzoyl chloride-aluminum chloride in pure, dry carbon bisulfide results in the formation of methoxy benzophenone-aluminum chloride. After the removal of the solvent by evaporation under vacuum the compound did not crystallize, even after several weeks, until a crystal of methoxy benzophenone-aluminum chloride (prepared by another method) was added, when crystallization occurred promptly.

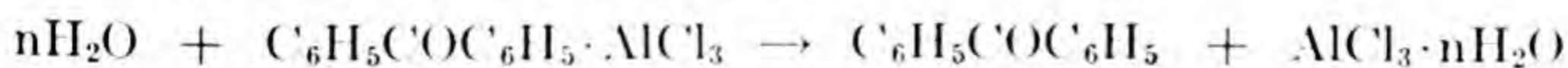


J. Boeseken, *Rec. trav. chim.*, **19**, 22 (1900)

27

**H₂O****I-565**

Benzophenone is formed quantitatively when its addition product with aluminum chloride reacts with water.

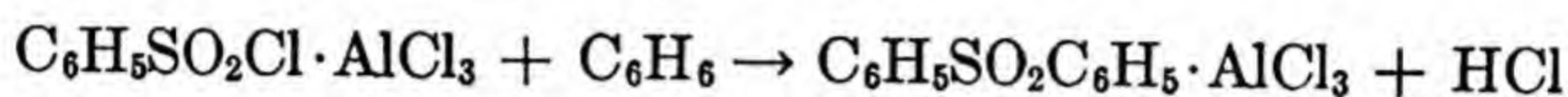


J. Boeseken, *Rec. trav. chim.*, **19**, 22 (1900)

27

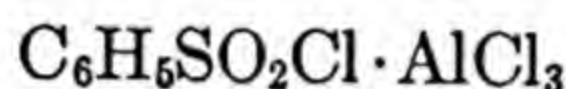
**C₆H₆****I-566**

When benzene is added to a solution of benzene sulfonic chloride-aluminum chloride in pure, dry carbon bisulfide, the benzene reacts with the chlorine of the aromatic to form a sulfone. The compound may be crystallized by removing the solvent by evaporation under vacuum. Pure diphenyl sulfone may be obtained by decomposing the complex in boiling 80% alcohol, cooling slowly, and allowing it to crystallize. The crystals should be washed with alcohol.

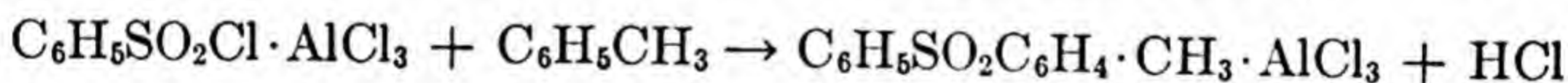


J. Boeseken, *Rec. trav. chim.*, **19**, 25 (1900)

27

**C₆H₅CH₃****I-567**

When toluene is added to a solution of benzene sulfonic chloride-aluminum chloride in pure, dry carbon bisulfide, the toluene reacts with the chlorine of the aromatic to form a sulfone. The compound may be crystallized by removing the solvent by evaporation under vacuum. Pure methyl diphenyl sulfone may be obtained by decomposing the complex with boiling 80% alcohol, cooling slowly, and allowing it to crystallize. The crystals should be washed with alcohol.

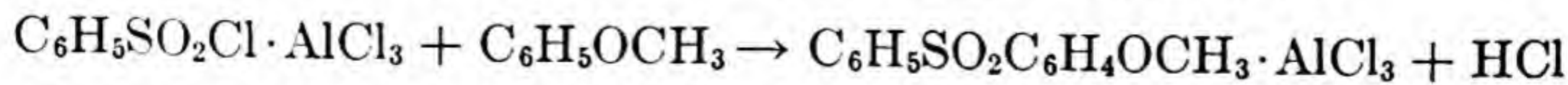


J. Boeseken, *Rec. trav. chim.*, **19**, 25 (1900)

27

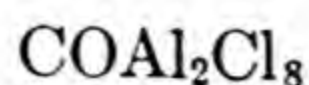
**C₆H₅OCH₃****I-568**

When anisol is added to a solution of benzene sulfonic chloride-aluminum chloride in pure, dry carbon bisulfide, the anisol reacts with the chlorine of the aromatic to form a sulfone. The compound may be obtained by removing the solvent by evaporation under vacuum. Pure methoxy diphenyl sulfone may be obtained by decomposing the complex in boiling 80% alcohol, cooling slowly, and allowing it to crystallize. The crystals should be washed with alcohol.



J. Boeseken, *Rec. trav. chim.*, **19**, 26 (1900)

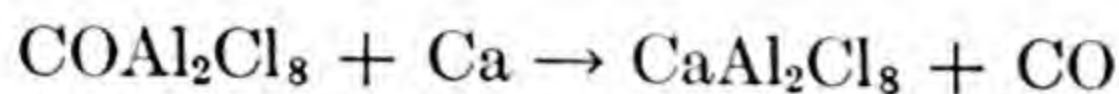
27



Ca

I-569

Metallic calcium reacts with phosgeno acid forming the calcium salt and carbon monoxide.



Germann and Timpany, J. Am. Chem. Soc., **47**, 2275 (1925)

1

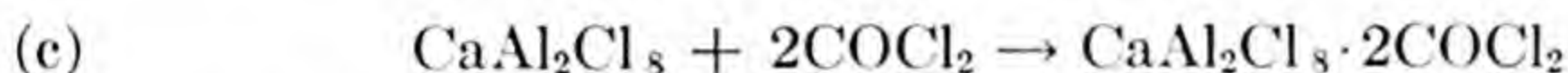
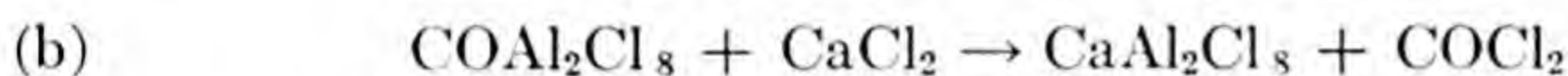
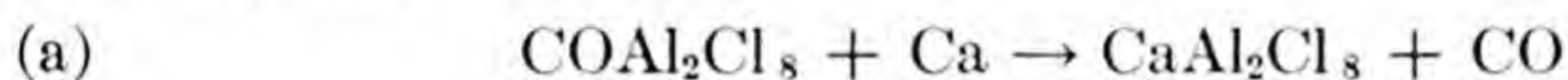


Ca

I-570

CaCl₂

Phosgeno acid is made by dissolving aluminum trichloride in liquid phosgene. It has the formula COAl_2Cl_8 , the carbonyl radical of which may be replaced by active metals, (a); or the acid may undergo double decomposition with salts of active metals, (b). Double salts may also be formed, (c).



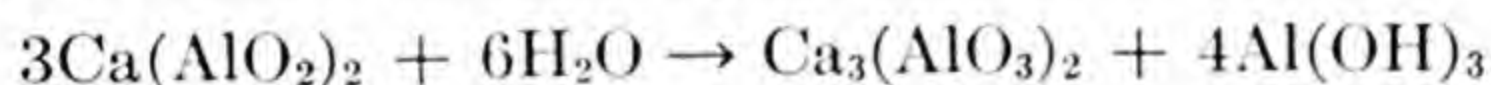
Germann and Timpany, J. Am. Chem. Soc., **47**, 2275 (1925)

25

H₂O

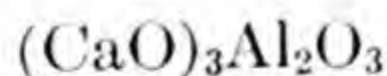
I-571

Calcium metaluminate combines slowly with water to form calcium orthoaluminate and aluminum hydroxide.



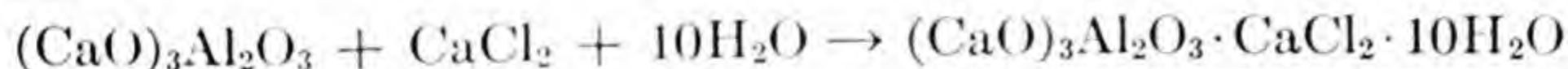
L. S. Wells, B. S. J. Res., **1**, 962 (1928)

9

CaCl₂

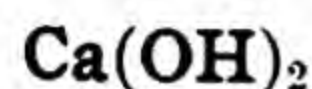
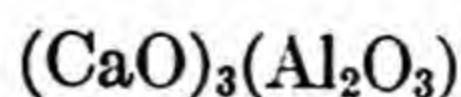
I-572

Addition of calcium chloride solution to calcium aluminate solutions causes the precipitation of sparingly soluble calcium chloraluminate crystals.



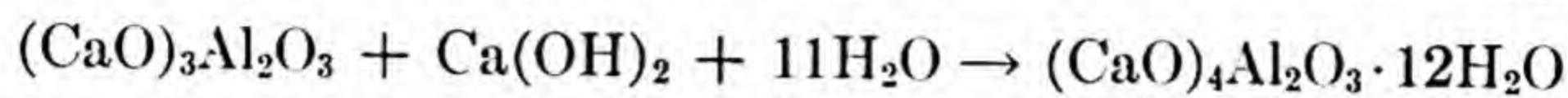
L. S. Wells, B. S. J. Res., **1**, 1003 (1928)

9



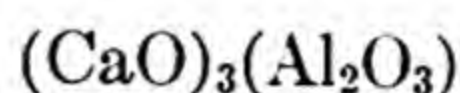
I-573

At pH greater than 12.0 hydrated tetracalcium aluminate is precipitated as a silky precipitate on mixing clear solutions of the reagents.



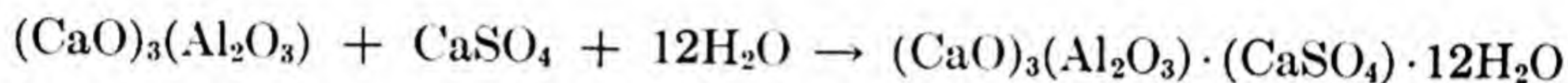
L. S. Wells, B. S. J. Res., **1**, 989 (1928)

9



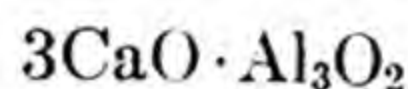
I-574

A solution of calcium aluminate and a saturated solution of calcium sulfate when mixed precipitate the low sulfate form of calcium sulfoaluminate.



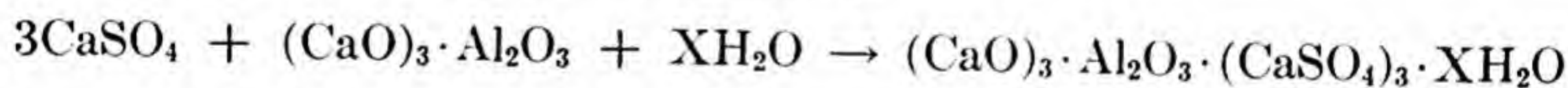
Lerch, Ashton and Bogue, B. S. J. Res., **2**, 723 (1929)

9



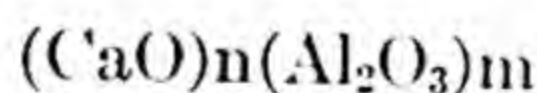
I-575

Calcium sulfate in solution enters into reaction with tricalcium aluminate to form a calcium sulfoaluminate.



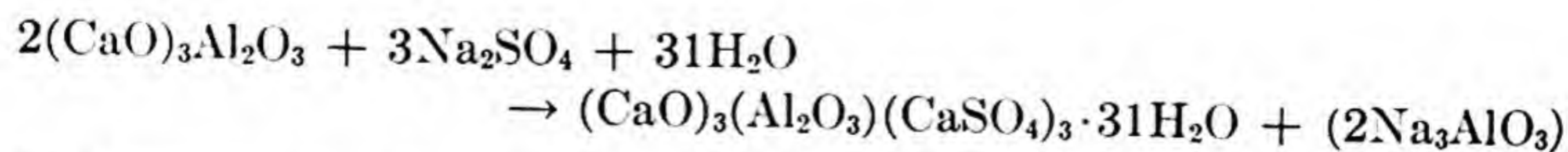
P. S. Roller, Ind. Eng. Chem., **26**, 672 (1934)

24



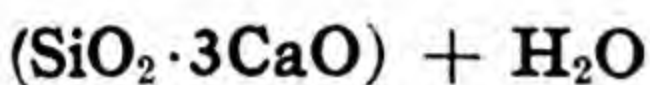
I-576

Sodium sulfate solutions added to any of the four anhydrous calcium aluminates (3:5, 1:1, 5:3, 3:1) react to produce a large increase in the volume of the solid phase and form large percentages of calcium sulfoaluminate.



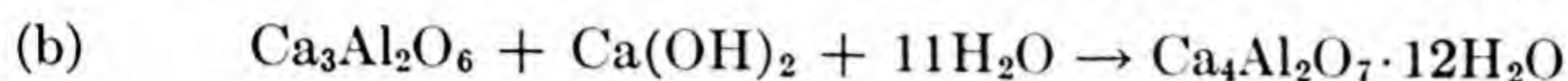
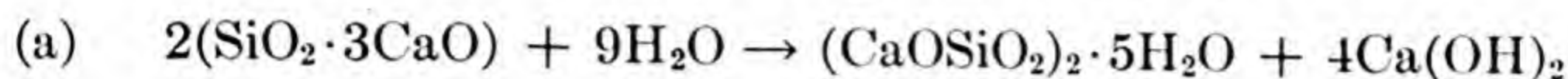
W. Lerch, F. W. Ashton and R. H. Bogue, B. S. J. Res., **2**, 721 (1929)

9



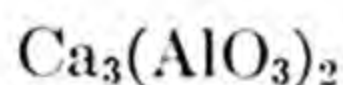
I-577

In the setting of cement the tricalcium silicate reacts to form a lower hydrated silicate and two molecules of calcium hydroxide. Tricalcium aluminate reacts with $\text{Ca}(\text{OH})_2$ to produce a hydrated crystal.



Burke and Pinckney, *J. Ind. Eng. Chem.*, **3**, 317 (1911)

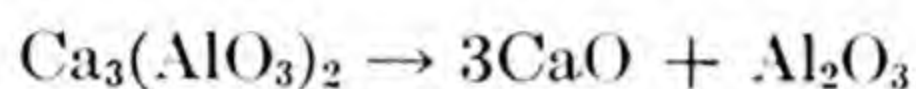
22



Δ

I-578

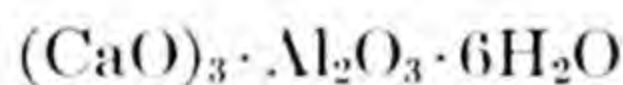
Tricalcium aluminate dissociates at 1540°C.



W. C. Hansen, *B. S. J. Res.*, **4**, 59 (1930)

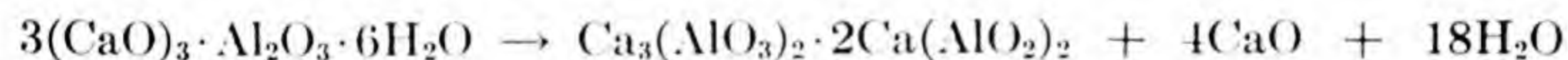
9

Δ



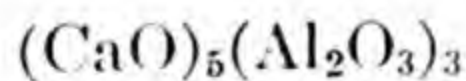
I-579

Hydrated tricalcium aluminate decomposes on ignition into the next lower aluminate. The product when treated with steam at 150° forms the hydrated tricalcium aluminate.



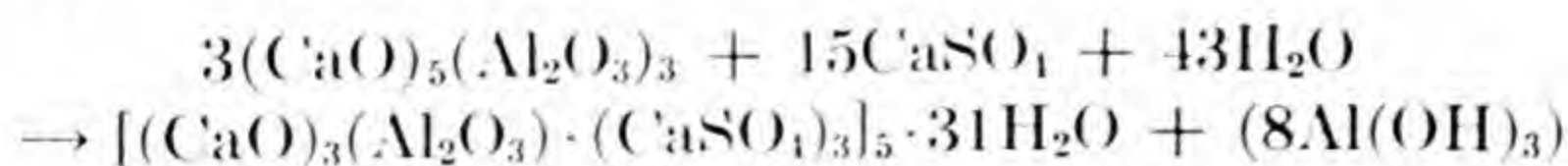
Thorwaldson and Grace, *Can. J. Res.*, **1**, 45 (1929)

94

CaSO₄

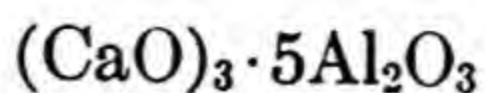
I-580

Twenty grams of 5:3 calcium aluminate is dissolved in 1 liter of water and the solution shaken for one hour, and filtered. 200 ml. of saturated CaSO_4 solution is added to the filtrate. Calcium sulfoaluminate crystallizes out very slowly in fine hexagonal needles.

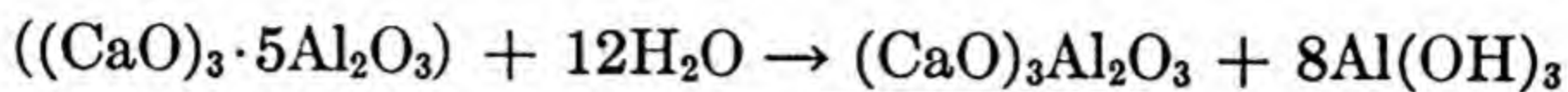


Lerch, Ashton and Bogue, *B. S. J. Res.*, **2**, 720 (1929)

9

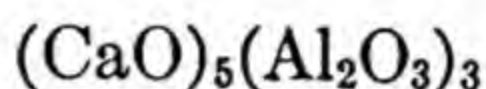
**H₂O****I-581**

3:5 calcium aluminate reacts with water to form metastable solutions from which tricalcium aluminate and aluminum hydroxide precipitate slowly.

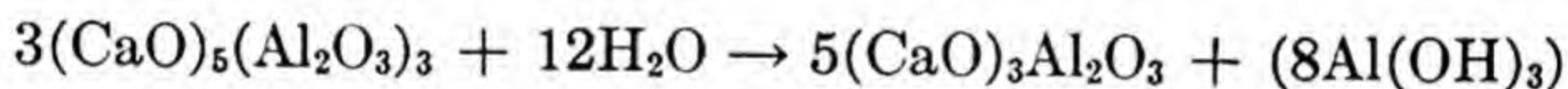


L. S. Wells, B. S. J. Res., 1, 965 (1928)

9

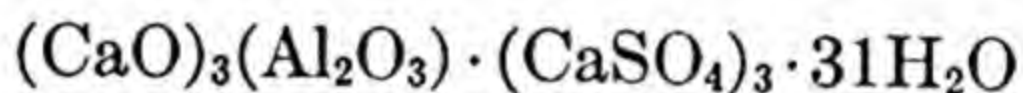
**H₂O****I-582**

5:3 calcium aluminate reacts with water to form metastable and supersaturated monocalcium aluminate solutions from which hydrated alumina and hydrated tricalcium aluminate subsequently precipitate as equilibrium is approached. A small amount of an unidentified phase is also formed.

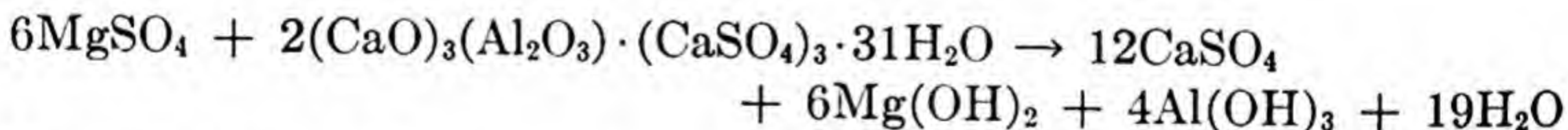


L. S. Wells, B. S. J. Res., 1, 971 (1928)

9

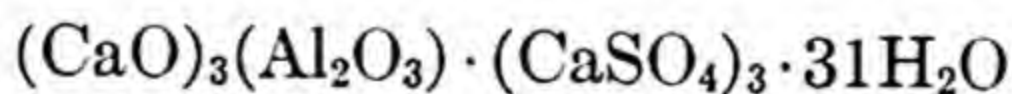
**MgSO₄****I-583**

Calcium sulfoaluminate is decomposed by 0.6 or 1.2% magnesium sulfate solution in 3 weeks.

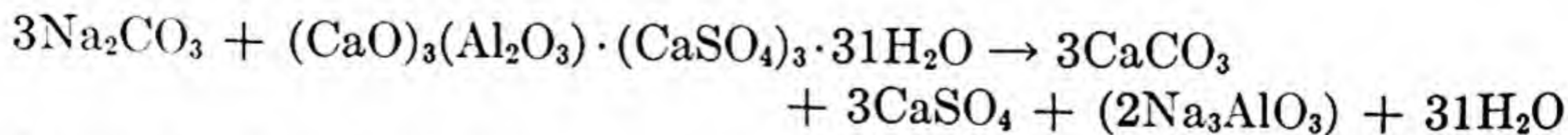


Lerch, Ashton and Bogue, B. S. J. Res., 2, 725 (1929)

9

**Na₂CO₃****I-584**

Calcium sulfoaluminate is decomposed by 3% sodium carbonate solution in three weeks.

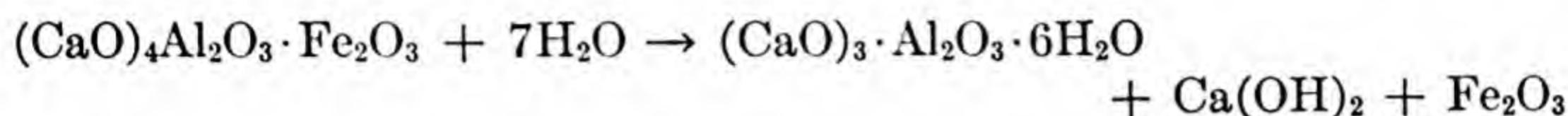


Lerch, Ashton and Bogue, B. S. J. Res., 2, 725 (1929)

9

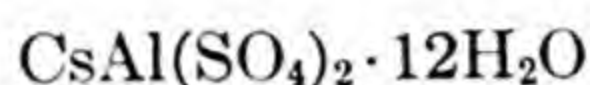
 H_2O **I-585**

Tetracalcium aluminoferrite exposed to saturated steam between 100–300°C. decomposes into ferric oxide, calcium hydroxide and the hexahydrate of tricalcium aluminate.

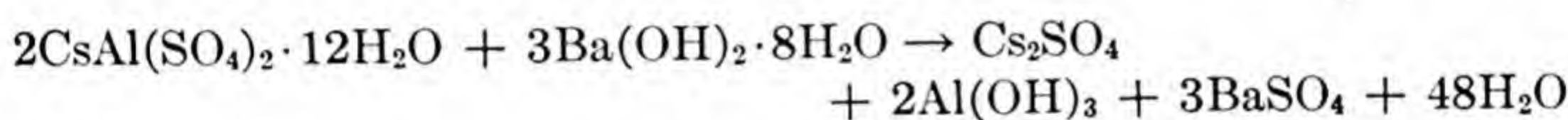


Mather and Thorvaldson, *Can. J. Res.*, **15B**, 337 (1937)

94

 $\text{Ba}(\text{OH})_2 \cdot 8\text{H}_2\text{O}$ **I-586**

Cesium alum is converted into cesium sulfate when a solution is mixed with a solution of crystalline barium hydroxide.

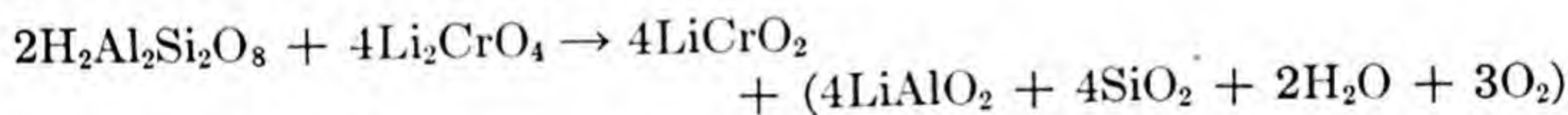


Erdman and Menke, *J. Am. Chem. Soc.*, **21**, 260 (1899)

1

 Li_2CrO_4 **I-587**

Lithium chromite is formed when a mixture of kaolin and lithium chromate is heated or fused for a long time.

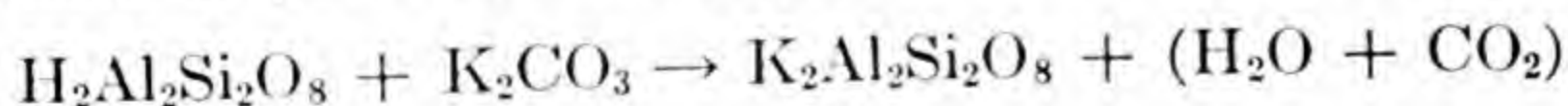


Weyberg, *Centr. Min.*, 645 (1906)

25

 K_2CO_3 **I-588**

A minutely crystalline compound is obtained when kaolin is fused with a large excess of potassium carbonate.

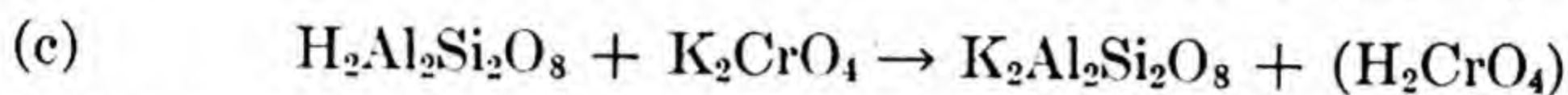
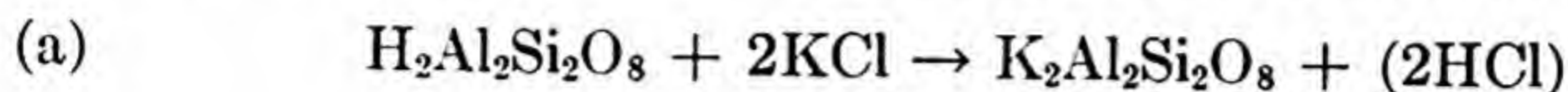


Weyberg, *Centr. Min.*, 395 (1908)
 Ref., *J. Chem. Soc. (London)*, **94**, 697 (1908)

25

**KCl****I-589**

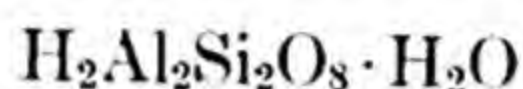
A minutely crystalline compound is obtained when kaolin is fused with a large excess of potassium chloride. Similar reactions occur when kaolin is fused with potassium sulfate and potassium chromate.



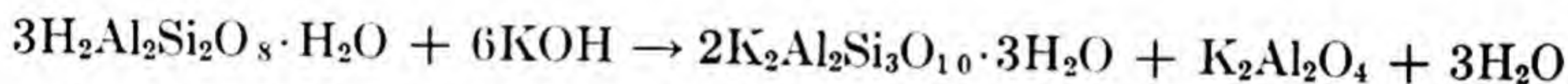
Weyberg, Centr. Min., 395 (1908)

Ref., J. Chem. Soc. (London), **94**, 697 (1908)

25

**KOH****I-590**

Potassium hydroxide decomposes kaolin into a trisilicate as shown in the equation.



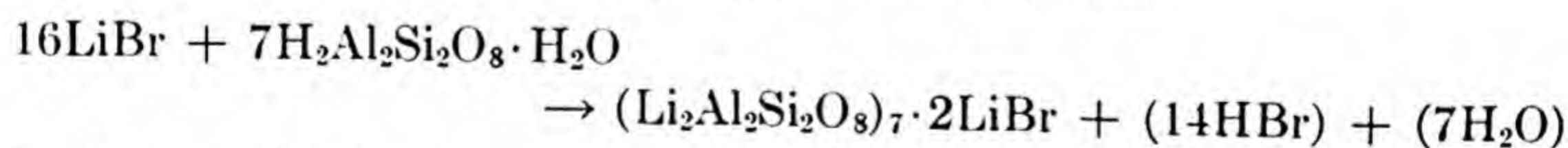
J. Lemberg, Z. deut. geol. Ges., **35**, 557 (1883)

Ref., *ibid.*, **40**, 625 (1888)

25

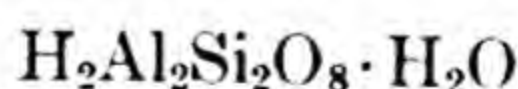
**LiBr****I-591**

When kaolin is fused with lithium bromide, a lithium bromo-sodalite crystallizing in rhombic dodecahedra is obtained.

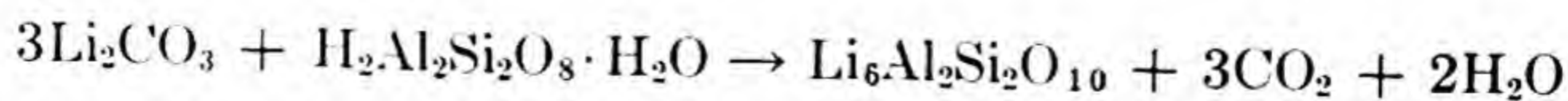


Z. Weyberg, Centr. Min., (1905), 646

2

**Li₂CO₃****I-592**

When lithium carbonate is fused with kaolin, a white crystalline powder is obtained.



Z. Weyberg, Centr. Min. (1905), 646

2

**LiCl****I-593**

Fuse kaolin with lithium chloride and a white, crystalline powder is obtained. The crystals are orthorhombic.

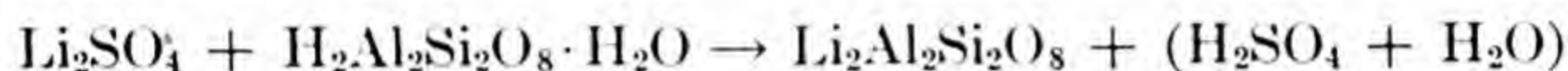


Z. Weyberg, *Centr. Min.* (1905), 646-655

2

**Li₂SO₄****I-594**

When lithium sulfate is fused with kaolin, a crystallized orthorhombic product results.

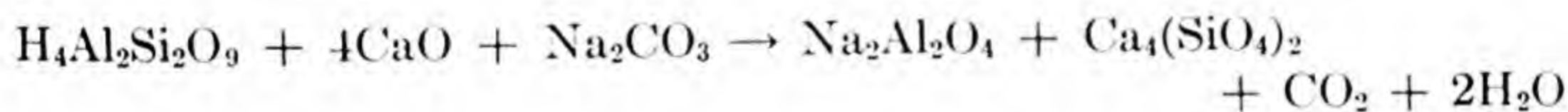


Z. Weyberg, *Centr. Min.* (1905), 646

2

**CaO + Na₂CO₃****I-595**

The mineral argile is decomposed by heating a mixture of it with lime and sodium carbonate.



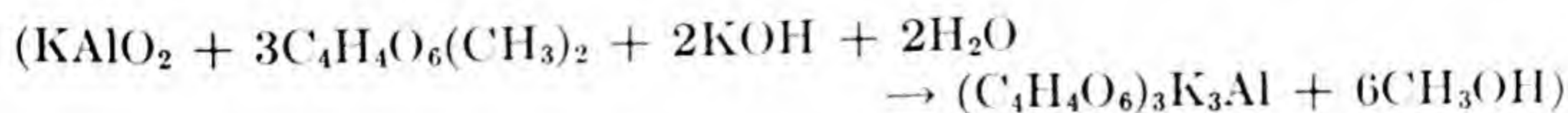
Mark Packard, *Chem. Zentr.* (1907) **1**, 1606; D. R. P. 182442

Ref., Carl Faessler, *Can. Chem. Met. Eng.*, **12**, 35 (1928)

15

**C₄H₄O₆(CH₃)₂****I-596**

In strongly alkaline solutions, potassium metaluminate forms a complex with methyl tartrate:



Yeu Ki Heng, *J. Chim. phys.*, **33**, 356 (1936)

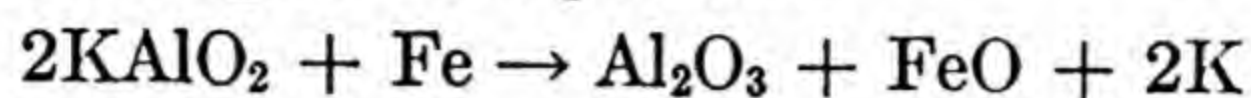
69



Fe

I-597

Iron reacts, in a vacuum, on most alkali metal compounds near their fusion temperatures. Potassium metaluminate is reduced by iron at about 1500°C according to the equation:



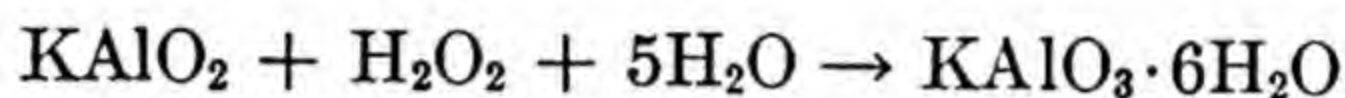
Hackspill and Pinck, Bull. Soc. Chim., (4), **41**, 1151 (1927)

31

H₂O₂

I-598

Potassium peraluminate is formed when hydrogen peroxide oxidizes potassium metaluminate in the cold solution. It is precipitated with alcohol.



Tanatar, Ber., **36**, 1893 (1903)

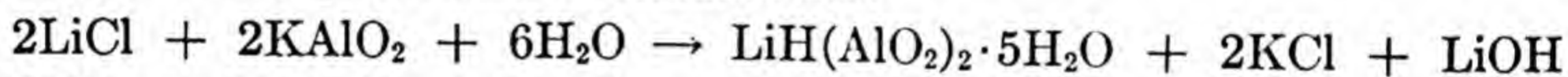
25



LiCl

I-599

Lithium hydrogen aluminate is prepared by mixing solutions of lithium chloride and potassium metaluminate.



J. Hegrousky, J. Chem. Soc. (London), **118**, 1013 (1920)

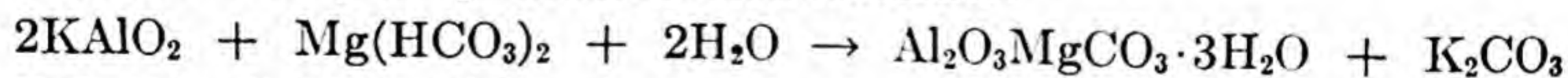
Ref., Dobbins and Sanders, J. Am. Chem. Soc., **54**, 178 (1932)

1

Mg(HCO₃)₂

I-600

A white horn-like mass is formed when magnesium hydrogen carbonate is added slowly to potassium metaluminate.



F. Loewig, D. R. P. 70175

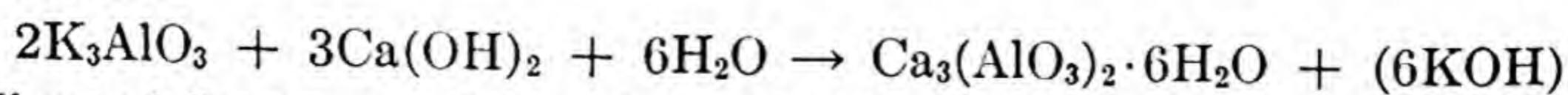
Ref., Ber., **26**, 951 (1893)

25

Ca(OH)₂

I-601

A white crystalline precipitate of calcium aluminate is formed when a hot solution of calcium hydroxide is treated with potassium orthoaluminate.



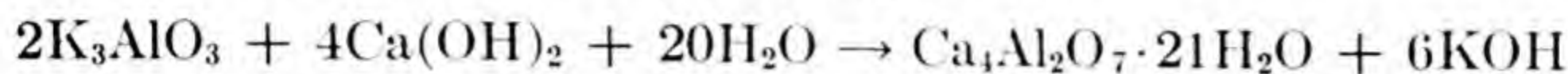
Allen and Rogers, Am. Chem. J., **24**, 304 (1900)

1

K_3AlO_3

Ca(OH)₂ **I-602**

When a solution of potassium aluminate and lime-water are mixed, crystallization begins very quickly and continues for hours; the product is a mass of crystals which are optically active.



H. le Chatelier, *Bull. soc. chim.* (2), **42**, 82 (1884).

44

K_3AlO_3

K₂CO₃ **I-603**

A precipitate is formed when a potassium carbonate solution is added drop by drop to a solution of potassium orthoaluminate.



Ditte, *Compt. rend.*, **116**, 386

Ref., *J. Chem. Soc. (London)*, **64**, 279 (1893)

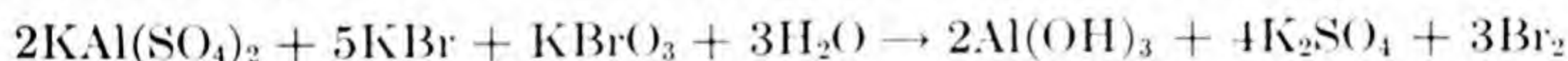
25

$\text{KAl(SO}_4)_2$

KBr **I-604**

KBrO₃

Aluminum hydroxide is obtained by the reaction of a solution of alum with a mixture of potassium bromide and potassium bromate.



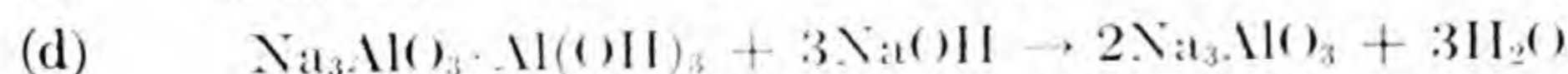
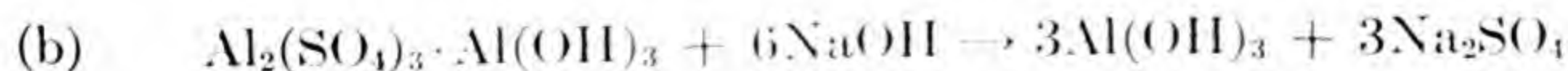
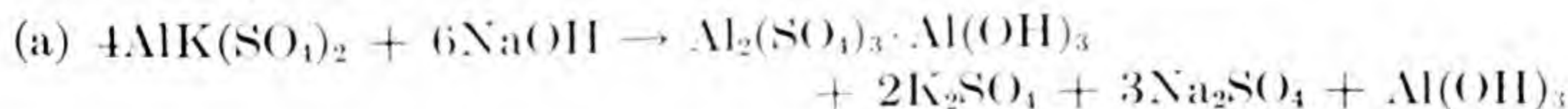
F. A. Gooch and R. W. Osborne, *Z. anorg. Chem.*, **55**, 188 (1907)

28

$\text{KAl(SO}_4)_2$

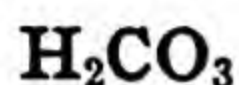
NaOH **I-605**

The addition of sodium hydroxide to a concentrated solution of potassium alum yields a series of basic salts after the reactions:



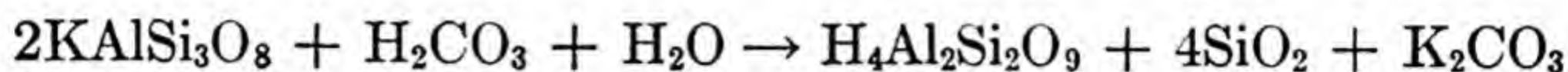
E. Grobet, *J. Chim. phys.*, **19**, 331 (1921)

69



I-606

The reaction by which potassium may be made available through the solvent action at the feeding points of roots may be represented as follows.



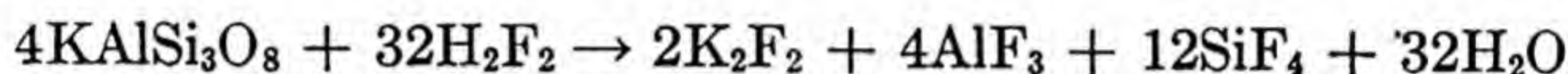
E. Truog, *Science*, **56**, 294 (1922)

44



I-607

Aluminum fluoride is formed when orthoclase is attacked by hydrofluoric acid.



Cushman and Hubbard, *J. Am. Chem. Soc.*, **30**, 790 (1908)

1



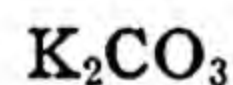
I-608

In the presence of abundant water the following equilibria may be assumed to exist in igneous magmas, the polysilicates partly breaking down into orthosilicates. A like reaction takes place with albite.



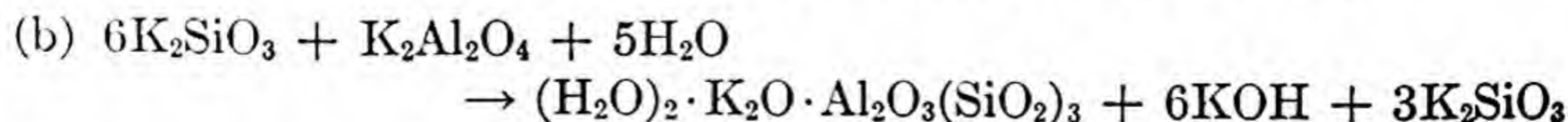
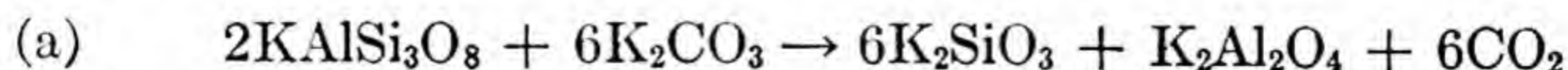
G. W. Tyrrell, *Trans. Far. Soc.*, **20**, 425 (1924)

85



I-609

A complex silicate is formed when the product resulting from the fusion of powdered orthoclase with potassium carbonate at dull red heat is treated with water.



Cushman and Hubbard, *J. Am. Chem. Soc.*, **30**, 796 (1908)

1

**KOH****I-610**

When feldspar is finely ground and mixed in water with 8 parts of its weight of KOH or NaOH and heated to 275–300°C for a period of one hour after the water has evaporated, the following reaction takes place. The product is soluble in water.

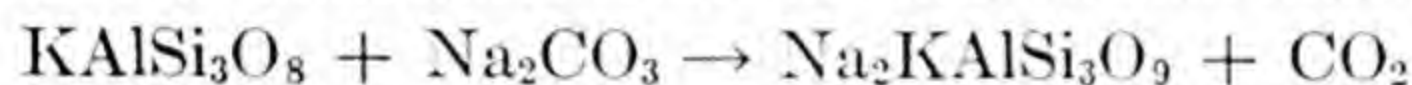


Frazier, Holland and Miller, *J. Ind. Eng. Chem.*, **9**, 936 (1917)

22

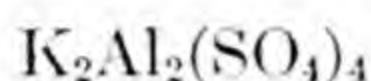
**Na₂CO₃****I-611**

When feldspar is heated to about 900–1000° with sodium carbonate, disodium potassium aluminum trisilicate and carbon dioxide are formed.

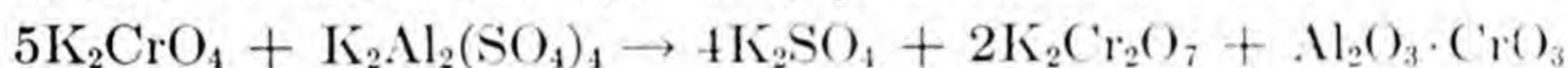


O. Petterson, *J. Chem. Soc. (London)*, **77**, 1293 (1900)

102

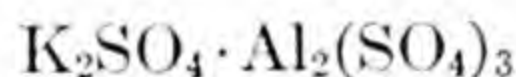
**K₂CrO₄****I-612**

A solution of alum is decomposed by potassium chromate.



Elliot and Storer, *Proc. Am. Acad.*, **5**, 214 (1862)

25

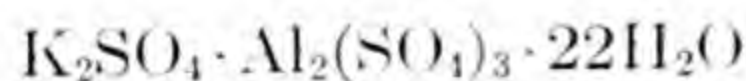
**KOH****I-613**

Potassium metaluminate is formed when a solution of potassium aluminum sulfate is allowed to react with a solution of potassium hydroxide at 30°–70°.

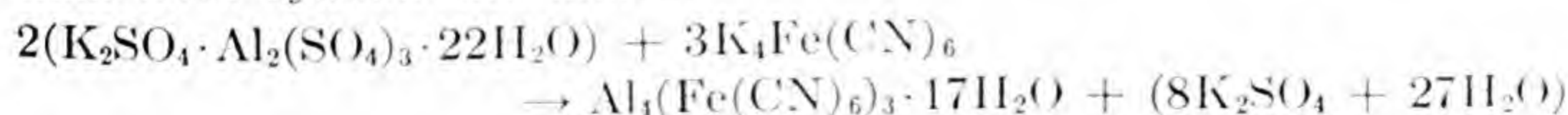


A. B. Prescott, *J. Am. Chem. Soc.*, **1**, 28 (1876)

1

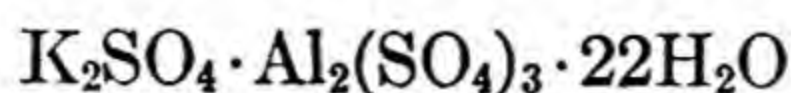
**K₄Fe(CN)₆****I-614**

A bluish white gelatinous precipitate of aluminum ferro cyanide is formed when hot concentrated solutions of potassium alum and potassium ferro cyanide are mixed.

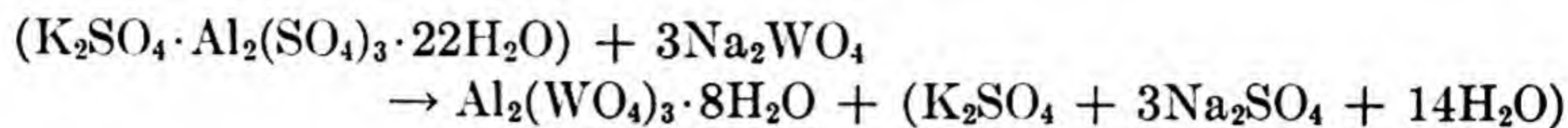


Wyrouboff, *Ann. Chim. Phys.*, **8**, 447

25

**Na₂WO₄****I-615**

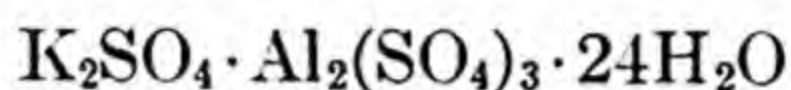
Neutral aluminum tungstate is formed as a precipitate when solutions of alum and sodium tungstate are mixed.



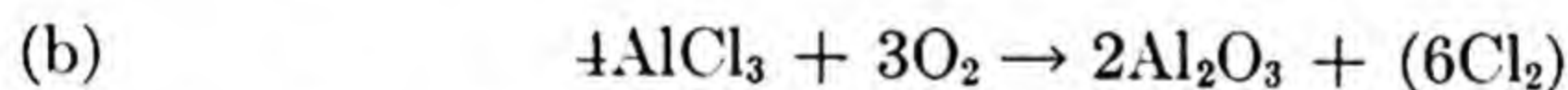
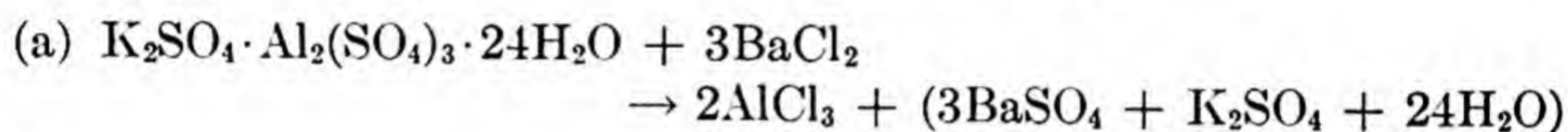
J. Lefort, *Compt. rend.*, **87**, 748

Ref., *Ad. Kopp, Ber.*, **12**, 362 (1879)

25

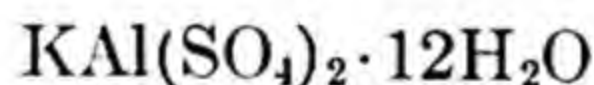
**BaCl₂****I-616**

Aluminum oxide is obtained when the aluminum chloride obtained by treating alum with barium chloride is heated to redness.

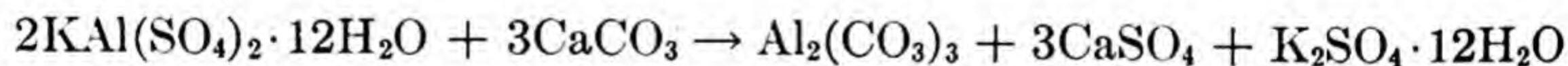


Poggendorff and Liebig, *Ann.*, **17**, 49 (1836)

1

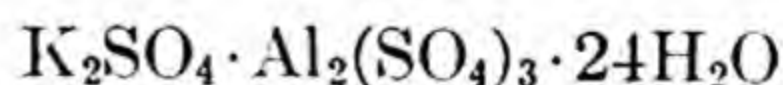
**CaCO₃****I-617**

Potassium alum reacts with salts in natural waters changing the basic nature of the water to neutral.

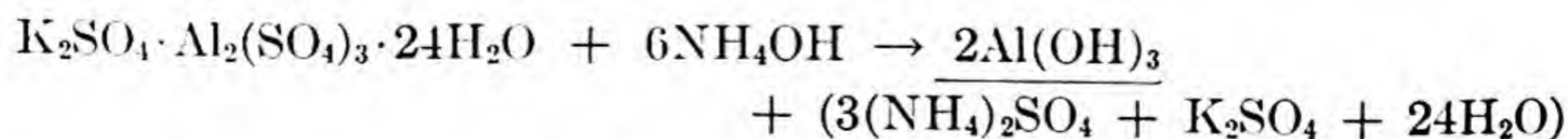


W. L. Lewis, *J. Ind. Eng. Chem.*, **8**, 917 (1916)

22

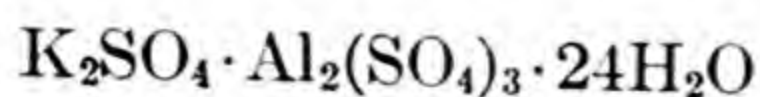
**NH₄OH****I-618**

Aluminum hydroxide precipitates when a saturated solution of potassium alum is treated with ammonium hydroxide.

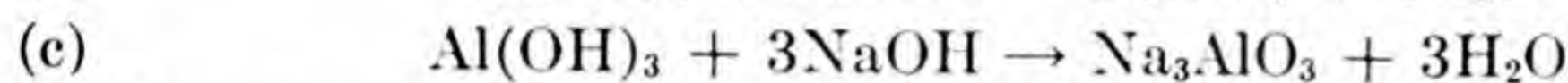
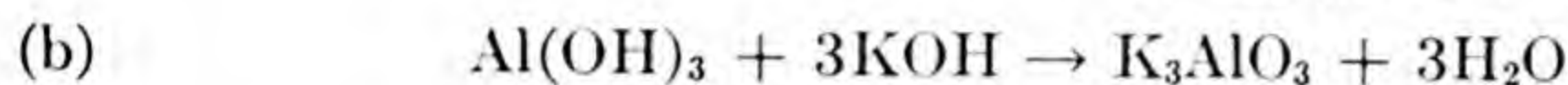


Poggendorff and Liebig, *Ann.*, **17**, 50 (1836)

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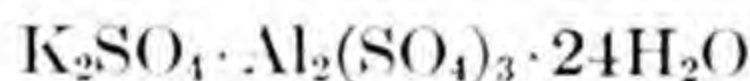
**NH₄OH****I-619****KOH****NaOH**

A solution of alum is precipitated with ammonium hydroxide. The resulting aluminum hydroxide is dried in a vacuum desiccator then shaken for 24 hours with potassium hydroxide solution. Soluble potassium aluminate is formed. The same type reaction occurs with sodium hydroxide solution.

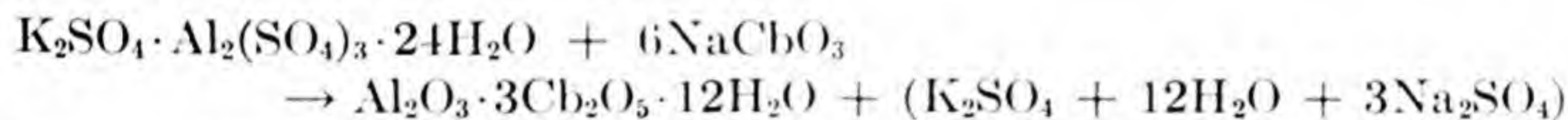


W. Herz, *Z. anorg. Chem.*, **25**, 155 (1900)

28

**NaCbO₃****I-620**

A white precipitate of aluminum columbate forms when a solution of alum reacts with sodium columbate.

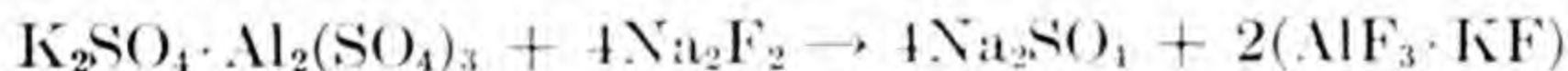


Balke and Smith, *J. Am. Chem. Soc.*, **30**, 1652 (1908)

1

**Na₂F₂****I-621**

Aluminum potassium fluoride is formed when anhydrous potassium alum and sodium fluoride are melted together.



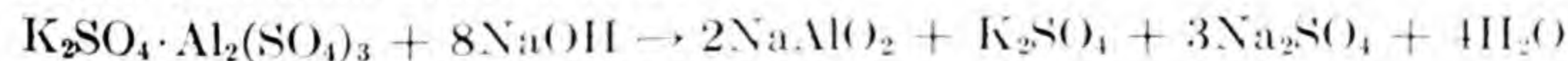
W. Diehl, *D. R. P.* 59447

Ref., *Ber.*, **25**, 250 (1892)

25

**NaOH****I-622**

Sodium metaluminate is formed when a solution of sodium hydroxide reacts with alum solution at 30°–70°.



A. B. Prescott, *J. Am. Chem. Soc.*, **1**, 28 (1876)

1

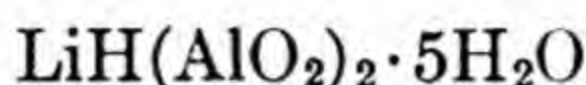
**Li₂SO₄****I-623**

A white sandy powdered substance, insoluble in water, is formed when lithium aluminum orthosilicate is fused for a long time with lithium sulfate.



Weyberg, *Centr. Min.*, 645 (1906)

25

**Δ****I-624**

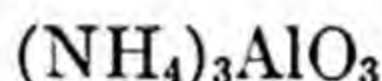
A lithium metaluminate-aluminum oxide is formed when acid lithium aluminate is moderately ignited.



J. Hegrousky, *J. Chem. Soc.*, **118**, 1013 (1920)

Ref., Dobbins and Sanders, *J. Am. Chem. Soc.*, **54**, 178 (1932)

1

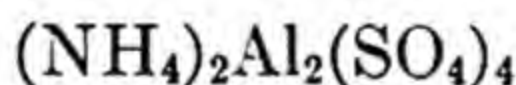
**Decomp.****I-625**

Aluminum hydroxide is formed along with the evolution of ammonia when ammonium aluminate decomposes.

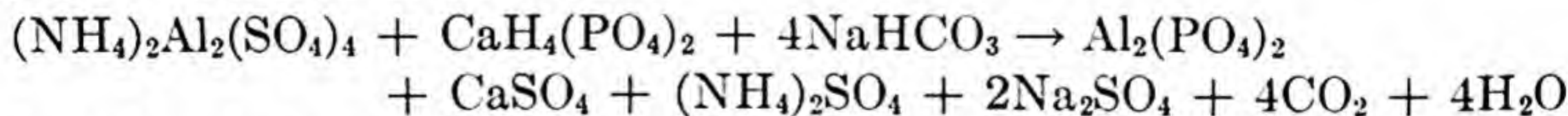


Gottig, *Ber.*, **29**, 1671 (1896)

25

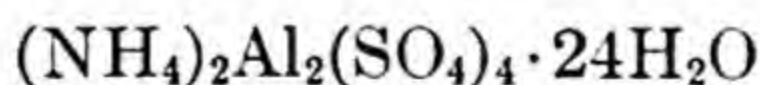
**CaH₄(PO₄)₂ + NaHCO₃****I-626**

Baking powder decomposes according to the following equation, to yield a mixture of products.

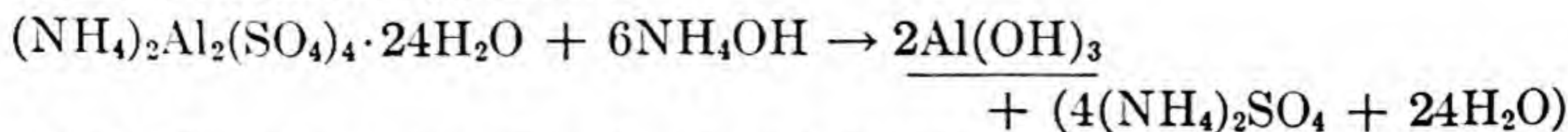


L. Pitkin, *J. Am. Chem. Soc.*, **12**, 454 (1890)

1

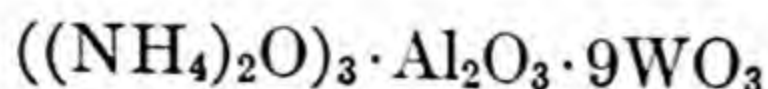
**NH₄OH****I-627**

Ammonia was added to a solution of ammonium alum, which precipitated aluminum hydroxide.

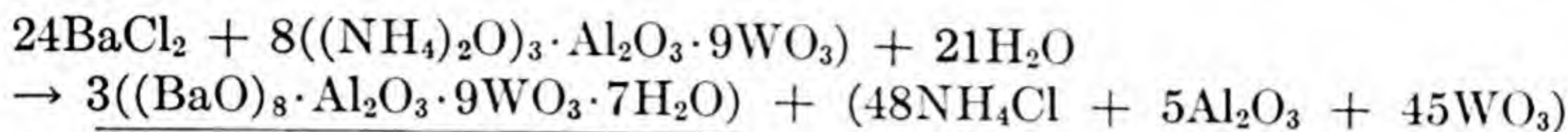


J. W. Mallet, *Trans. Roy. Soc. (London)*, **171**, 1003-35 (1881)

105

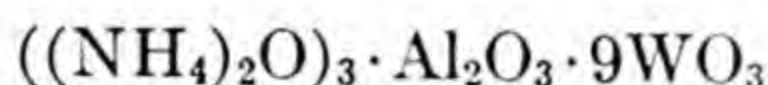
**BaCl₂****I-628**

Barium "aluminico" tungstate is the white precipitate formed when a solution of barium chloride is treated with ammonium "aluminico" tungstate.

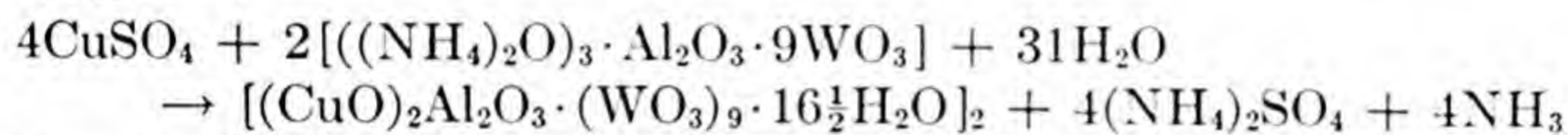


L. C. Daniels, J. Am. Chem. Soc., **30**, 1848 (1908)

1

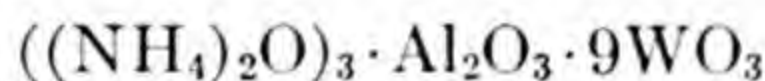
**CuSO₄****I-629**

Copper aluminico-tungstate is formed as a precipitate by adding to a 10% solution of copper sulfate, a solution of ammonium aluminico-tungstate.

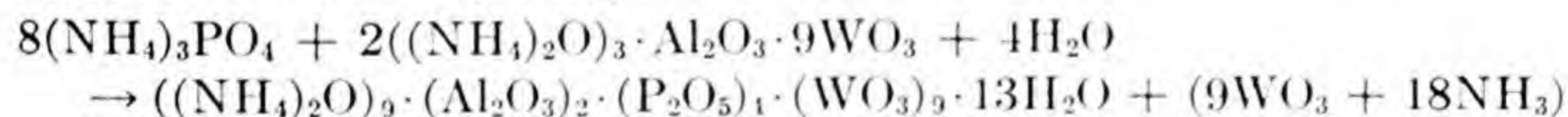


L. C. Daniels, J. Am. Chem. Soc., **30**, 1847 (1908)

1

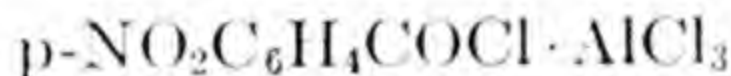
**(NH₄)₃PO₄****I-630**

Ammonium aluminico-phosphotungstate separates as a white powder when a concentrated solution of orthophosphoric acid or a solution of ammonium phosphate containing an excess of ammonia, is treated with ammonium aluminico-tungstate.



L. C. Daniels, J. Am. Chem. Soc., **30**, 1851 (1908)

1

**C₆H₆****I-631**

When benzene is added to a solution of para-nitrobenzoyl chloride-aluminum chloride in pure, dry carbon disulfide, the benzene reacts with the chlorine of the aromatic to form a ketone. The compound may be crystallized by removing the solvent by evaporation under vacuum. Pure para-nitrobenzophenone may be obtained by decomposing the complex in boiling 80% alcohol, cooling slowly, and allowing it to crystallize. The crystals should be washed with alcohol.

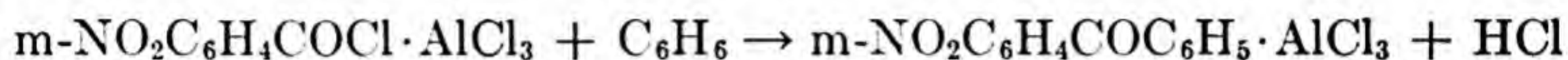


J. Boeseken, Rec. trav. chim., **19**, 25 (1900)

27

**C₆H₆****I-632**

When benzene is added to a solution of meta-nitrobenzoyl chloride-aluminum chloride in pure, dry carbon disulfide, the benzene reacts with the chlorine of the aromatic to form a ketone. The compound may be crystallized by removing the solvent by evaporation under vacuum. Pure meta-nitrobenzophenone may be obtained by decomposing the complex in boiling 80% alcohol, cooling slowly, and allowing it to crystallize. The crystals should be washed with alcohol.

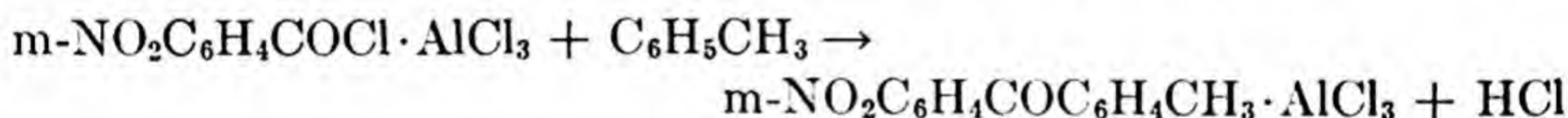


J. Boeseken, *Rec. trav. chim.*, **19**, 24 (1900)

27

**C₆H₅CH₃****I-633**

When toluene is added to a solution of meta-nitrobenzoyl chloride-aluminum chloride in pure, dry carbon disulfide, the toluene reacts with the chlorine of the aromatic to form a ketone. The compound may be crystallized by removing the solvent by evaporation under vacuum. Pure meta-nitro methyl benzophenone may be obtained by decomposing the complex in boiling 80% alcohol, cooling slowly, and allowing it to crystallize. The crystals should be washed with alcohol.

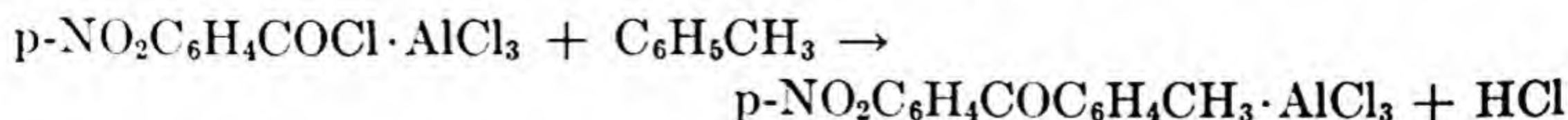


J. Boeseken, *Rec. trav. chim.*, **19**, 24 (1900)

27

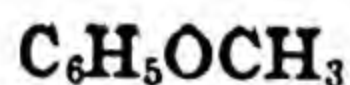
**C₆H₅CH₃****I-634**

When toluene is added to a solution of para-nitrobenzoyl chloride-aluminum chloride in pure, dry carbon disulfide, the toluene reacts with the chlorine of the aromatic to form a ketone. The compound may be crystallized by removing the solvent by evaporation under vacuum. Pure para-nitro methyl benzophenone may be obtained by decomposing the complex in boiling 80% alcohol, cooling slowly, and allowing it to crystallize. The crystals should be washed with alcohol.



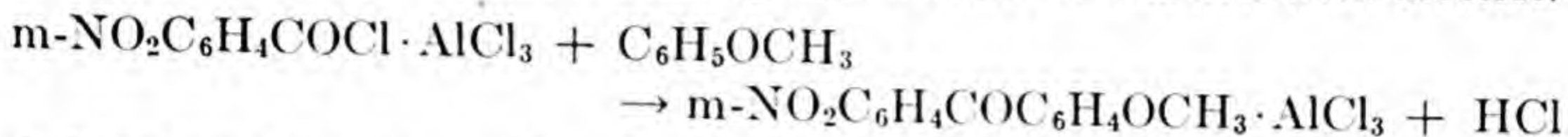
J. Boeseken, *Rec. trav. chim.*, **10**, 25 (1900)

27



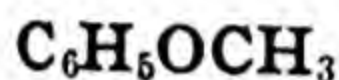
I-635

When anisol is added to a solution of meta-nitrobenzoyl chloride-aluminum chloride in pure, dry carbon disulfide, the anisol reacts with the chlorine in the aromatic to form a ketone. The compound may be crystallized by removing the solvent by evaporation under vacuum. Pure meta-nitro methoxy benzophenone may be obtained by decomposing the complex in boiling 80% alcohol, cooling slowly, and allowing it to crystallize. The crystals should be washed with alcohol.



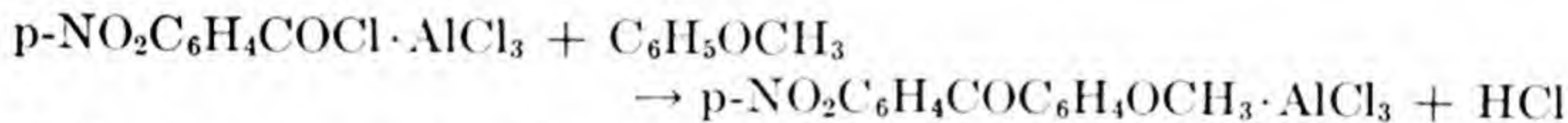
J. Boeseken, *Rec. trav. chim.*, **19**, 25 (1900)

27



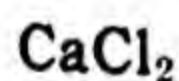
I-636

When anisol is added to a solution of para-nitrobenzoyl chloride-aluminum chloride in pure, dry carbon disulfide, the anisol reacts with the chlorine of the aromatic to form a ketone. The compound may be crystallized by removing the solvent by evaporation under vacuum. Pure para-nitro methoxy benzophenone may be obtained by decomposing the complex in boiling 80% alcohol, cooling slowly, and allowing it to crystallize.



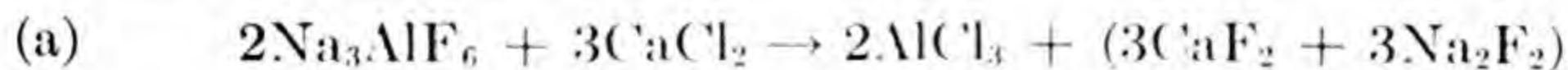
J. Boeseken, *Rec. trav. chim.*, **19**, 25 (1900)

27



I-637

Aluminum is formed when cryolite and calcium chloride are melted together and the resulting aluminum chloride reduced with metallic sodium or manganese.



or



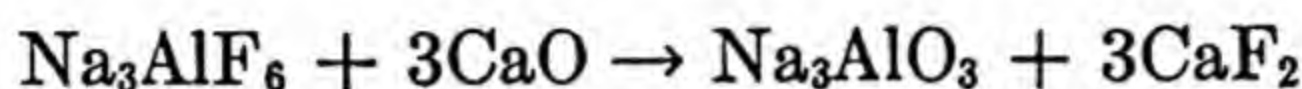
W. Weldon, *Brit. Pat.* 97 (1883)

Ref., R. Biedermann, *Ber.*, **17**, 90 (1884)

25

**CaO****I-638**

Cryolite or sodium aluminum fluoride may be used for the preparation of alkali aluminate (or alumina) if it is heated together with calcium oxide.

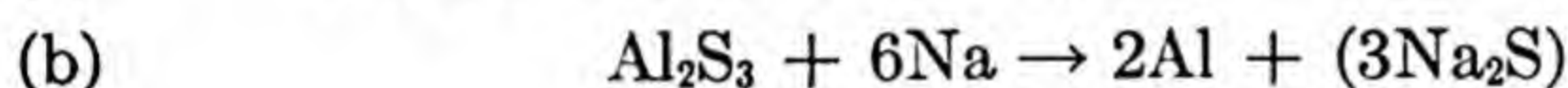
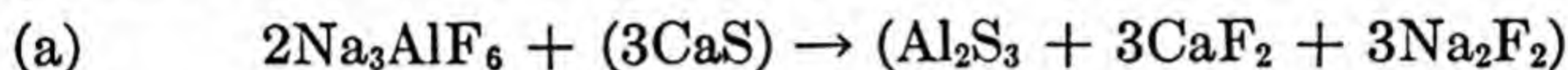


V. Gerber, *Z. Elektrochem.*, **25**, 193 (1919)

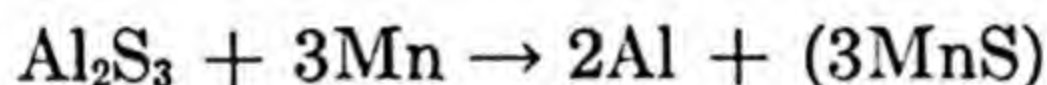
86

**CaS****I-639**

Aluminum is formed when cryolite and calcium sulfide are melted together and the melt reduced with metallic sodium or manganese.



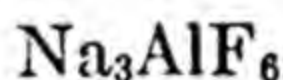
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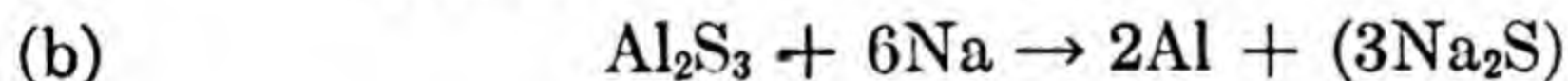
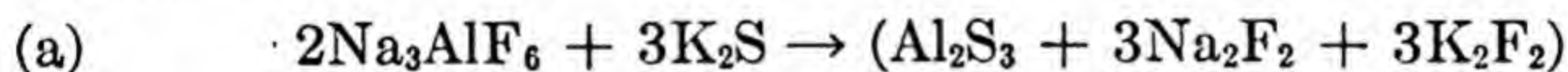
W. Weldon, *Brit. Pat.* 97 (1883)

Ref., R. Biedermann *Ber.*, **17**, 90 (1884)

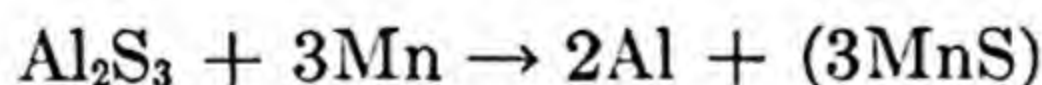
25

**K₂S****I-640**

Aluminum is formed when cryolite and potassium sulfide are melted together and the melt reduced with sodium or manganese.



or



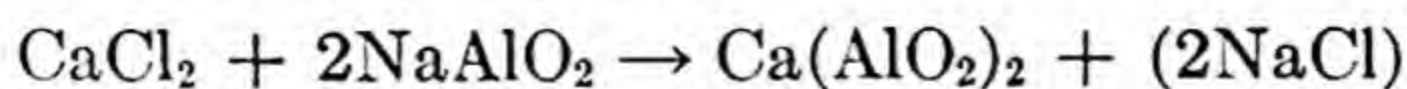
W. Weldon, *Brit. Pat.*, P. 97 (1883)

Ref., R. Biedermann *Ber.*, **17**, 90 (1884)

25

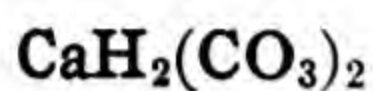
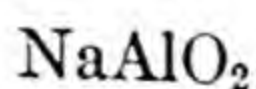
**CaCl₂****I-641**

Addition of calcium chloride solution to sodium metaluminate causes precipitation of calcium metaluminate.



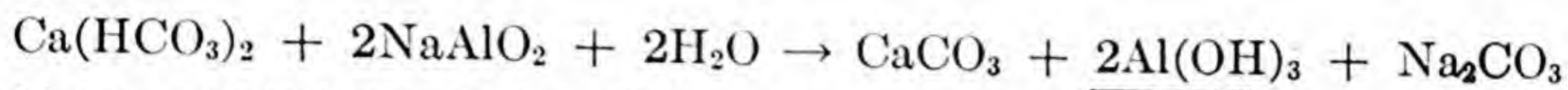
J. K. Wood, *J. Chem. Soc. (London)*, **93**, 419 (1908)

57



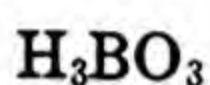
I-642

Aluminum hydroxide is precipitated when sodium metaluminate is added to water containing calcium bicarbonate or other suspended matters.

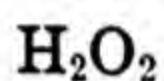


Mabery and Baltzley, J. Am. Chem. Soc., **21**, 23 (1899)

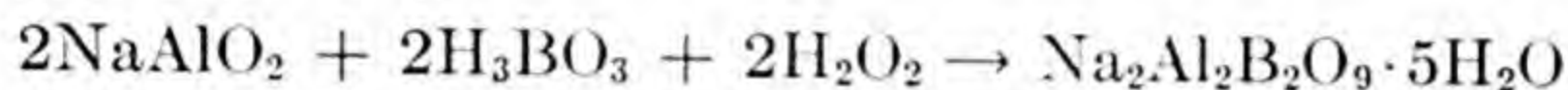
1



I-643



A white powdered precipitate was obtained when a cooled solution of sodium aluminate was slowly treated with a 10% solution of hydrogen peroxide and boric acid.



Chemische Fabrik Coswig-Anhalt, D.R.P. 235,050

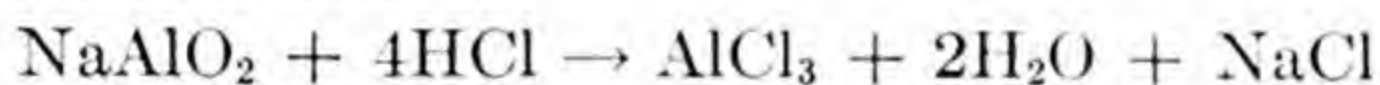
Ref., J. Chem. Soc., **100**, 984

25



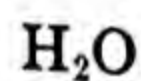
I-644

Sodium metaluminate was dissolved in boiling hydrochloric acid, thus forming aluminum chloride.



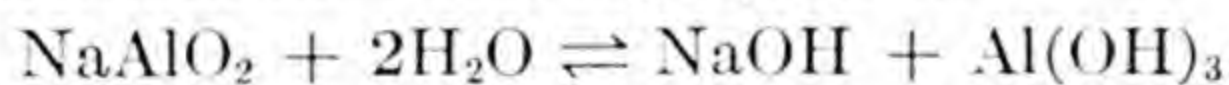
Richard Chenevix, Trans. Roy. Soc. (London), **92**, 331 (1802)

105



I-645

The solution of any soluble aluminate always reacts alkaline due to hydrolysis, as shown in the following equation.



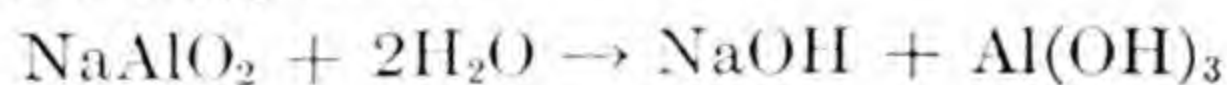
W. T. McGeorge, J. F. Breazeale and P. S. Burgess, Science, **64**, 504 (1926)

44



I-646

A solution of sodium metaluminate when heated over a water bath precipitates aluminum hydroxide. The reaction proceeds to about 60% at 100°, and 35% at 25°.



J. K. Wood, J. Chem. Soc. (London), **93**, 422 (1908)

57



I-647

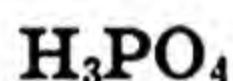
To a concentrated solution of sodium aluminate an excess of orthophosphoric acid is added, and the mixture heated in a sealed tube to 250°C. The product, "Al₂(PO₄)₂", in the form of small hexagonal prisms, is obtained, having a sp. gr. 2.59. It does not melt at white heat nor is it soluble in HCl or HNO₃.



A. deSchulten, Compt. rend., **98**, 1583

Ref., Pinner, Ber., **17**, 408 (1884)

29



I-648

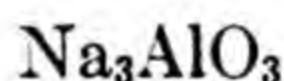
Aluminum orthophosphate is formed when sodium metaluminate and phosphoric acid are heated together in a closed tube at 250°.



A. Schulten, Compt. rend., **98**, 1583

Ref., Ber., **17**, 408 (1884)

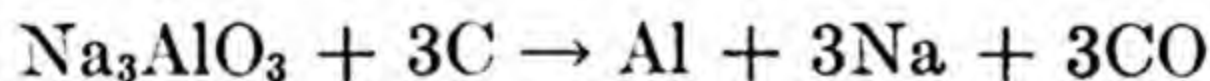
25



C

I-649

Metallic aluminum is formed and vapors of sodium and carbon monoxide escape when a mixture of sodium orthoaluminate and carbon is heated either in the absence of air or with a reducing flame.



E. Meyer, D.R.P. 59888

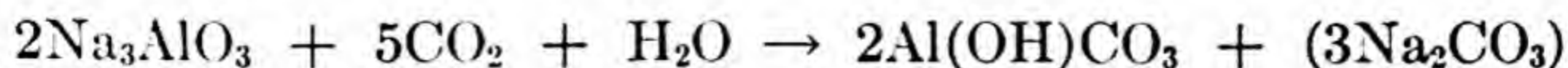
Ref., Ber., **25**, 295 (1893)

25



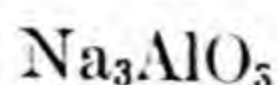
I-650

Sodium orthoaluminate saturated with carbon dioxide forms basic aluminum carbonate.

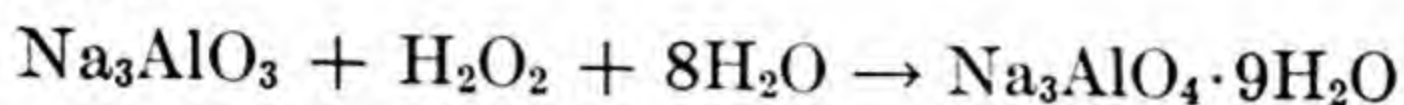


W. C. Day, Am. Chem. J., **19**, 707 (1897)

13

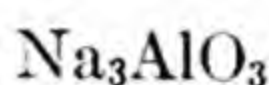
**H₂O₂****I-651**

Sodium peraluminate is formed when sodium aluminate is oxidized by hydrogen peroxide.



Tanatar, Ber., **36**, 893 (1903)

25

**H₃PO₄****I-652**

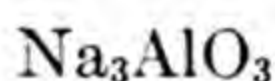
Aluminum phosphate is obtained as small hexagonal crystals when sodium aluminate and phosphoric acid are heated together in a closed tube at 250°C.



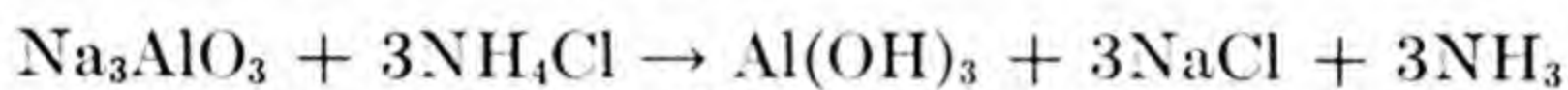
A. Schulten, Compt. rend., **98**, 1583

Ref., Ber., **17**, 408 (1884)

25

**NH₄Cl****I-653**

Aluminum hydroxide precipitates when sodium orthoaluminate is boiled with ammonium chloride.

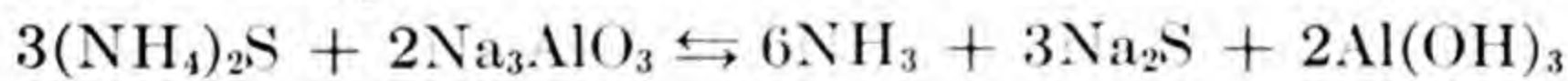


E. Ebler, Z. anal., Chem., **47**, 665 (1908)

25

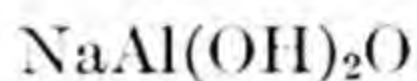
**(NH₄)₂S****I-654**

Aluminum is only partially precipitated from alkaline solutions at ordinary temperatures by ammonium sulfide. At the boiling point the precipitation is complete because of the removal of ammonia.



A. Travers, Chim. et Ind., **1**, 708 (1918)

91

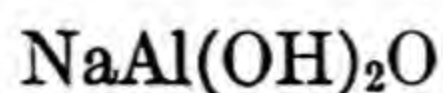
**Br₂****I-655**

Sodium bromate is formed and aluminum hydroxide is precipitated when bromine reacts with sodium meta basic aluminate above 60°C.

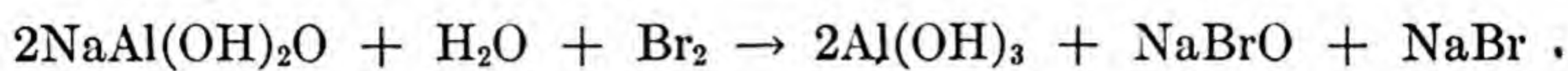


W. Jakob, Z. anal. Chem., **52**, 651 (1913)

25

**Br₂****I-656**

Sodium hypobromite and aluminum hydroxide are formed when bromine reacts with sodium metabasic aluminate below 60°C.

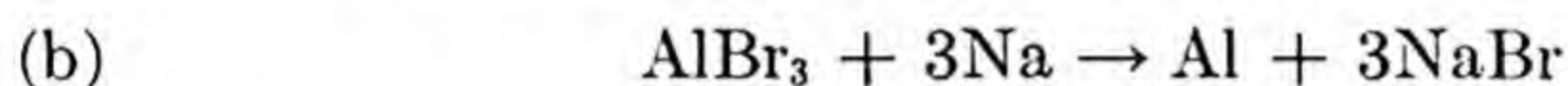
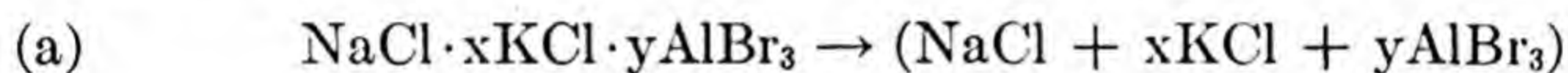


W. Jakob, Z. anal. Chem., **52**, 651 (1913)

28

**Na****I-657**

The sodium and potassium chlorides and aluminum bromide complex was added to a fused bath of sodium and potassium chlorides. To this sodium was added yielding metallic aluminum.

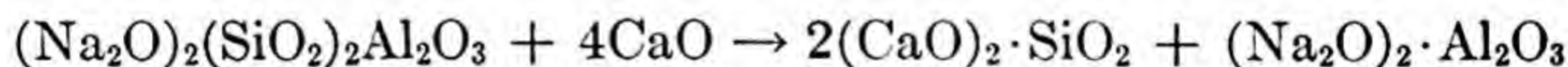


J. W. Mallette, Trans. Roy. Soc. (London), **171**, 1003-35, (1881)

105

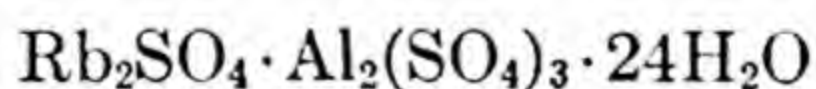
**CaO****I-658**

Sodium silico aluminate when mixed with lime produces a cinder-like substance which is easily crumbled, when heated in a rotary kiln.

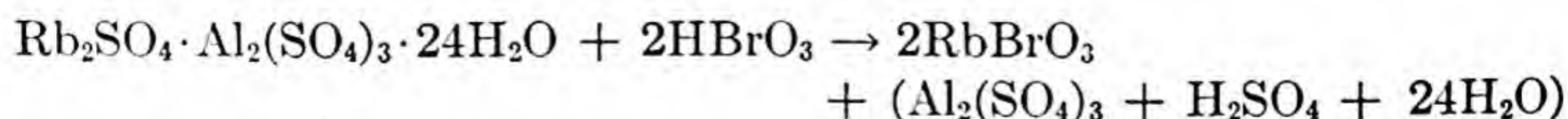


A. H. Cowles, J. Ind. Eng. Chem., **5**, 333 (1913)

22

**HBrO₃****I-659**

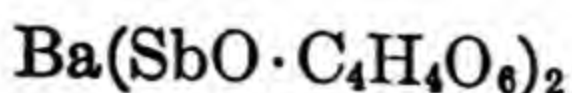
Rubidium bromate is formed when rubidium alum is treated with bromic acid in excess and allowed to crystallize.



Buell and McCrosky, J. Am. Chem. Soc., **43**, 2032 (1921)

1

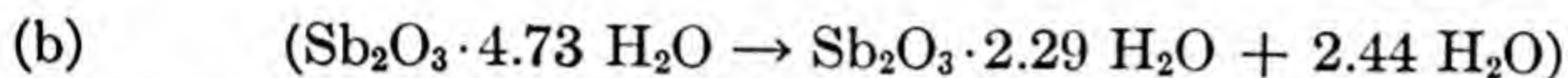
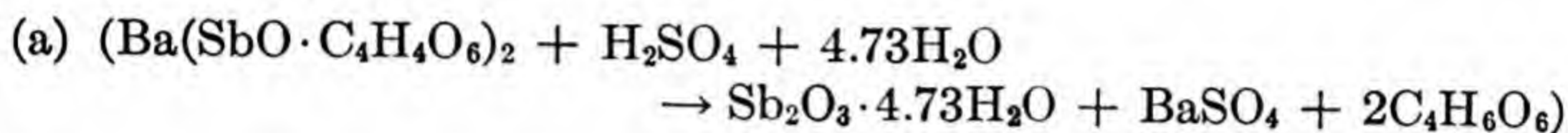
ANTIMONY

 H_2SO_4

I-660

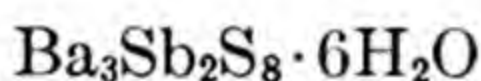
An aqueous solution of barium antimonyl tartrate is mixed in the cold with a solution containing the theoretical amount of sulfuric acid needed for double decomposition; barium sulfate precipitates and the filtrate, upon boiling, yields a white precipitate of the hydrated antimonious oxide shown in (a).

This oxide loses water upon heating it to constant weight in a steam oven (b).



Charles Lea and John K. Wood, *J. Chem. Soc.*, **123**, 261 (1923)

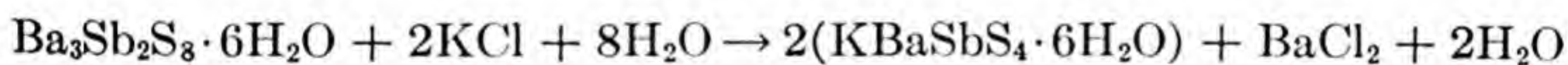
48



KCl

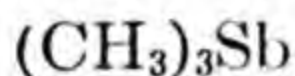
I-661

A solution of barium orthothioantimonate will react with a solution of potassium chloride. By concentrating and cooling this solution colorless crystals of potassium-barium orthothioantimonate are obtained.



E. Glatzel, *Z. anorg. Chem.*, **72**, 100 (1911)

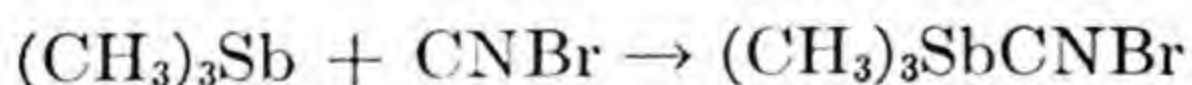
28



CNBr

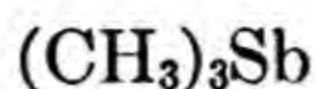
I-662

Care being taken to exclude air, trimethylstibine is added with shaking to a petroleum ether solution of cyanogen bromide, cooled to -5° , to form colorless, crystalline trimethyl antimony cyanobromide. The compound is insoluble in cold anhydrous organic solvents.

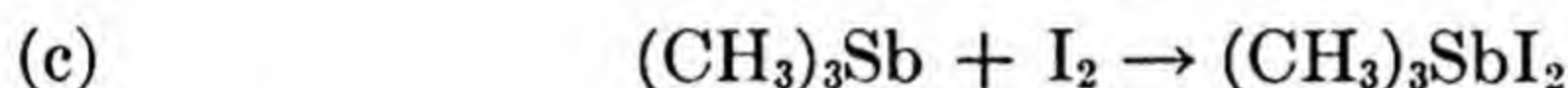
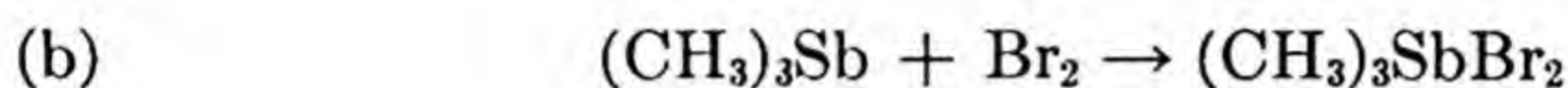
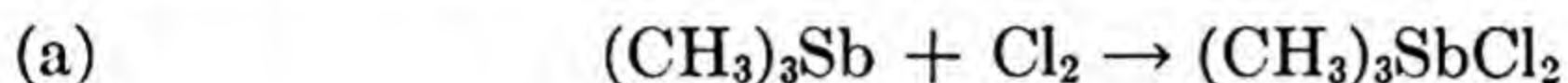


G. T. Morgan and V. E. Yarsley, *Proc. Roy. Soc. (London)*, **110A**, 535 (1926)

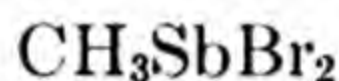
110

**Cl₂****I-663****Br₂****I₂**

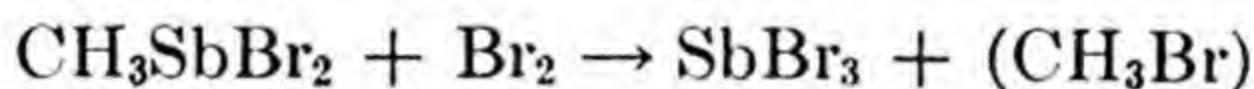
On adding an ethereal solution of chlorine, bromine or iodine to trimethylstibine, the corresponding trimethylstibine dihalide is formed. The dichloride and dibromide may be recrystallized from hot water as colorless needles. The iodide is yellow and less soluble.



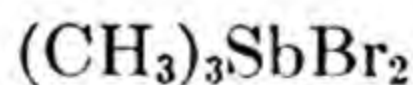
G. T. Morgan and G. R. Davies, Proc. Roy. Soc. (London), **110A**, 525 (1926) 110

**Br₂****I-664**

Methylstibine dibromide in carbon disulfide is demethylated by adding bromine. Antimony tribromide separates. Methylstibine diiodide does not combine with iodine under these conditions.



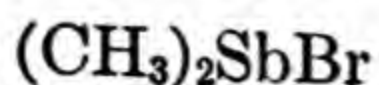
G. T. Morgan and G. R. Davies, Proc. Roy. Soc. (London), **110A**, 527 (1926) 110

**Δ****I-665**

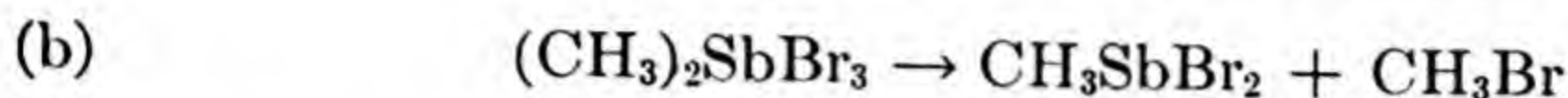
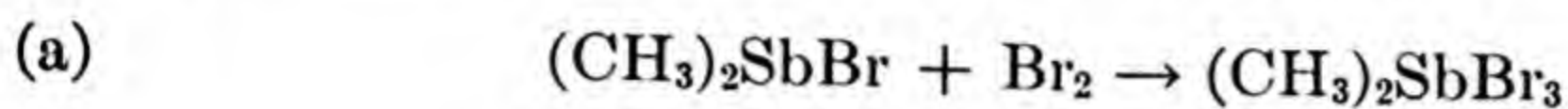
When trimethyl antimony dibromide is heated in a current of carbon dioxide at 80–100 mm. pressure, dimethylstibine bromide is formed. On redistillation it boils at 175–180°/750 mm. and slowly solidifies to almost colorless crystals melting at 89°. The compound is spontaneously inflammable in air at 50°.



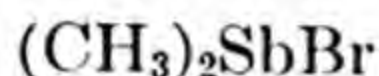
G. T. Morgan and G. R. Davies, Proc. Roy. Soc. (London), **110A**, 529 (1926) 110

**Br₂****I-666**

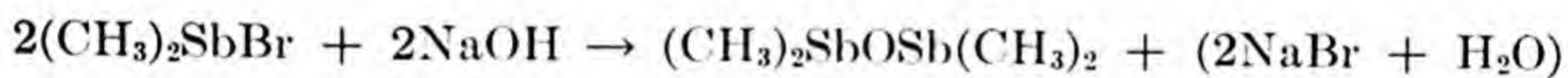
A yellowish white precipitate of feathery needles of dimethyl antimony tribromide forms when dimethylstibine bromide is added to bromine (1 mole) in carbon disulfide at -10° . The compound rapidly loses methyl bromide, forming methylstibine dibromide.



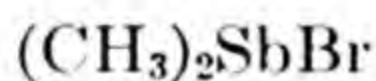
G. T. Morgan and G. R. Davies, Proc. Roy. Soc. (London), **110A**, 531 (1926) 110

**NaOH****I-667**

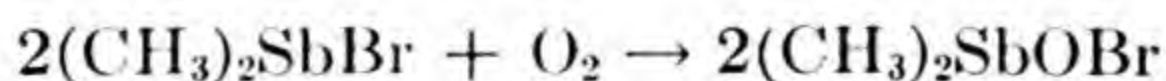
When treated with aqueous sodium hydroxide or potassium carbonate solution, dimethylstibine bromide is converted into bisdimethyl antimony oxide, a colorless oil which is spontaneously inflammable in air at ordinary temperatures.



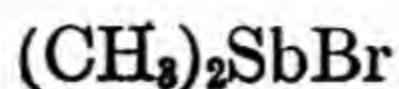
G. T. Morgan and G. R. Davies, Proc. Roy. Soc. (London), **110A**, 532 (1926) 110

**O₂****I-668**

White, amorphous dimethyl antimonyl bromide is formed when dimethylstibine bromide is covered with petroleum ether and shaken in air occasionally to cause slow oxidation. The compound is moderately soluble in hot water and gives a precipitate of silver bromide with silver nitrate.



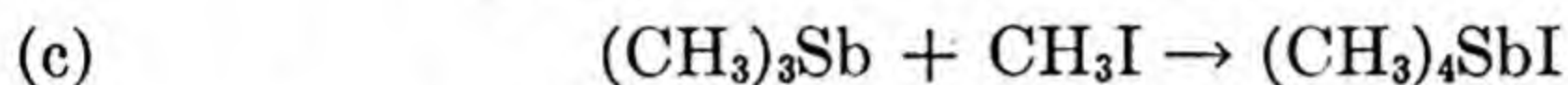
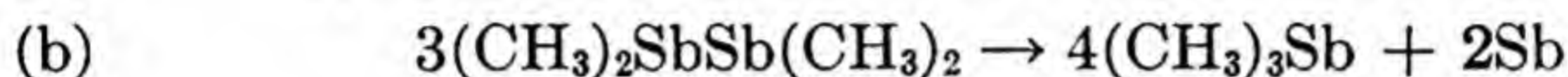
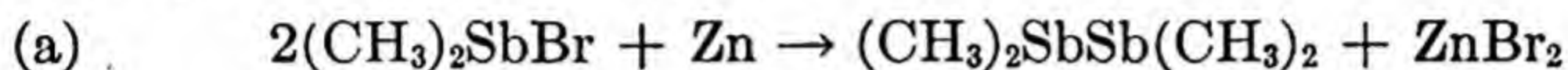
G. T. Morgan and G. R. Davies, Proc. Roy. Soc. (London), **110A**, 530 (1926) 110



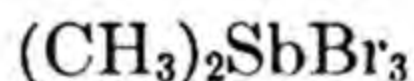
Zn

I-669

When dimethylstibine bromide is heated with zinc in sealed tubes filled with carbon dioxide, zinc bromide, antimony, trimethylstibine and some antimony cacodyl are formed. Addition of methyl iodide to the oily, less volatile part of the reaction mixture produces tetramethyl stibonium iodide and the compound in (e). The latter may be prepared from its components.



G. T. Morgan and G. R. Davies, Proc. Roy. Soc. (London), **110A**, 532 (1926) 110



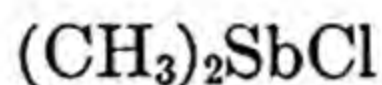
Δ

I-670

On leaving dimethyl antimony tribromide in a desiccator, the crystalline substance becomes viscid with loss of methyl bromide and finally resolidifies to methylstibine dibromide, which melts at 42° after recrystallization from carbon disulfide and ether. The compound is non-inflammable.

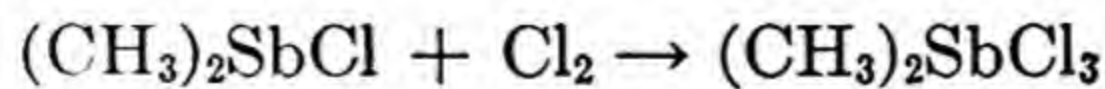


G. T. Morgan and G. R. Davies, Proc. Roy. Soc. (London), **110A**, 533 (1926) 110

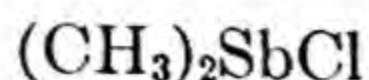
Cl₂

I-671

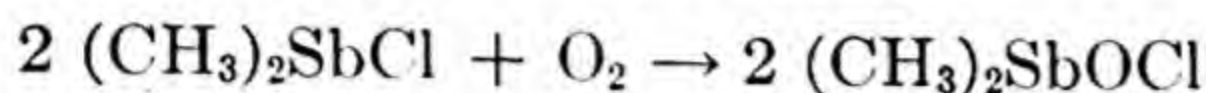
To prepare dimethyl antimony trichloride, 10 grams of dimethylstibine chloride is added to 50 ml. of carbon disulfide saturated at about -15° with chlorine. Chlorination is continued until a brown color develops. The white, crystalline compound which forms is collected and dried under vacuum; m.p. 105-110° with evolution of gas. The compound loses methyl chloride, leaving a colorless, oily liquid.



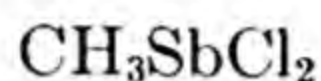
G. T. Morgan and G. R. Davies, Proc. Roy. Soc. (London), **110A**, 528 (1926) 110

**O₂****I-672**

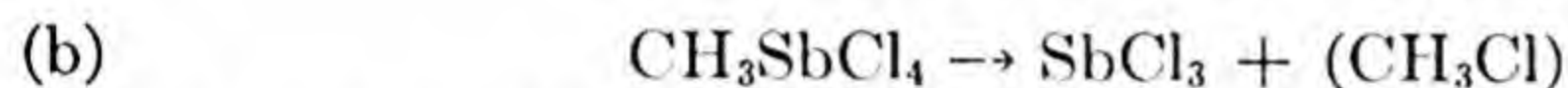
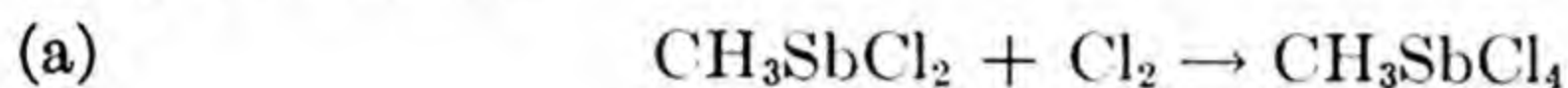
Dimethyl stibine oxychloride is obtained when dimethyl stibine chloride is allowed to oxidize slowly. The product is odorless, white, amorphous, and moderately soluble in hot water.



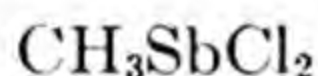
G. T. Morgan and G. R. Davies, Proc. Roy. Soc. (London), **110A**, 525 (1926) 110

**Cl₂****I-673**

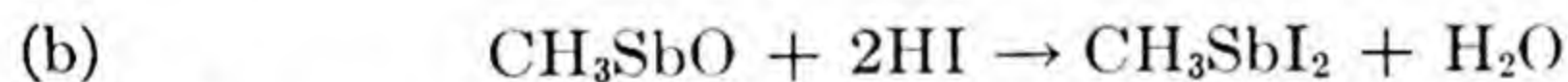
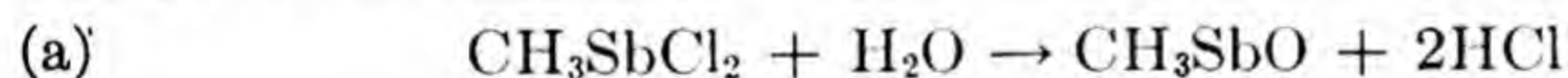
Methylstibine dichloride takes up chlorine in carbon disulfide forming an oily methylantimony tetrachloride which on warming yields antimony trichloride.



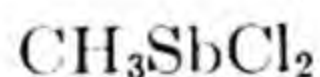
G. T. Morgan and G. R. Davies, Proc. Roy. Soc. (London), **110A**, 527 (1926) 110

**H₂O****I-674**

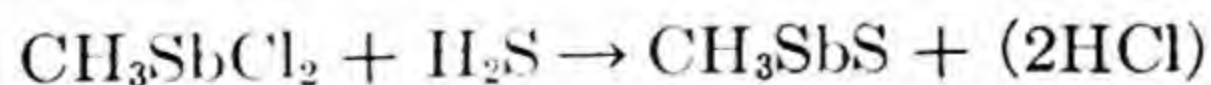
White, amorphous methylstibine oxide is prepared by agitating methylstibine dichloride with water, the solution being kept neutral by the occasional addition of dilute alkali. Hydriodic acid converts it to methylstibine diiodide.



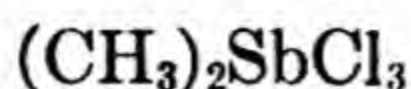
G. T. Morgan and G. R. Davies, Proc. Roy. Soc. (London), **110A**, 534 (1926) 110

**H₂S****I-675**

The action of hydrogen sulfide on any methylstibine dihalide forms a lemon yellow precipitate which is slightly soluble in benzene or carbon disulfide. The product from either of these solvents is an amorphous, yellow powder which fuses at about 70° to a resinous mass, and consists of methylstibine sulfide.



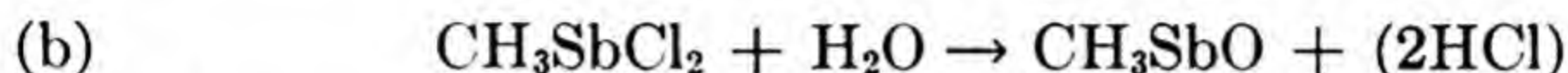
G. T. Morgan and G. R. Davies, Proc. Roy. Soc. (London), **110A**, 533 (1926) 110



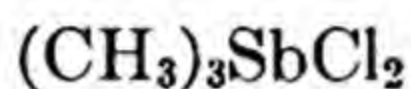
Δ

I-676

Methylstibine dichloride is obtained when dimethylantimony trichloride is heated at 600 mm. pressure to drive off methyl chloride. The oil is distilled at 115–120°/60 mm. It is decomposed by water, yielding methylstibine oxide, CH_3SbO .



G. T. Morgan and G. R. Davies, Proc. Roy. Soc. (London), **110A**, 533 (1926) 110



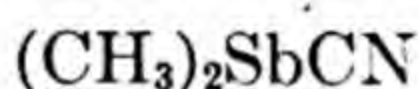
Δ

I-677

Trimethyl antimony dichloride is heated in a distilling flask under 600 mm. pressure in a current of carbon dioxide, giving methyl chloride and dimethyl stibine chloride, b.p. 155–160°/750 mm. The latter is spontaneously inflammable in air at 40° and has a pungent, disagreeable odor. With chloroplatinic acid it forms an orange precipitate.

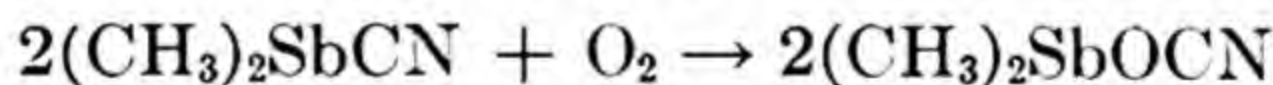


G. T. Morgan and G. R. Davies, Proc. Roy. Soc. (London), **110A**, 525 (1926) 110

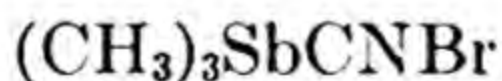
O₂

I-678

Dimethylstibine cyanide is readily oxidized by air to dimethyl antimonyl cyanide, a white crystalline compound which sinters slightly at 120° and decomposes at higher temperatures.

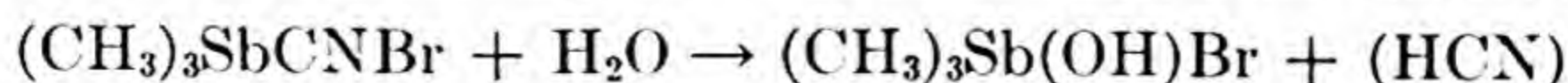


G. T. Morgan and V. E. Yarsley, Proc. Roy. Soc. (London), **110A**, 536 (1926) 110

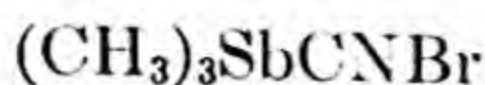
H₂O

I-679

Trimethyl antimony cyanobromide is readily hydrolyzed to trimethyl antimony hydroxobromide. The compound is white, crystalline, soluble in cold water, and separates from alcoholic solution in lustrous white needles which decompose without melting when heated.

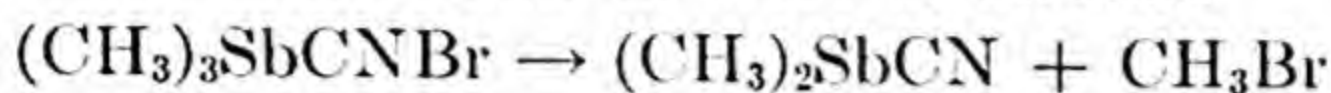


G. T. Morgan and V. E. Yarsley, Proc. Roy. Soc. (London), **110A**, 536 (1926) 110

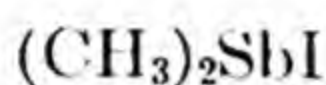
 Δ

I-680

Trimethylstibine cyanobromide heated to 160° at 10 mm. pressure in an air-free apparatus forms dimethylstibine cyanide. The compound, purified by resublimation, melts at $113\text{--}114^\circ$, has a nauseating odor, and is insoluble in water but soluble in ether or alcohol.

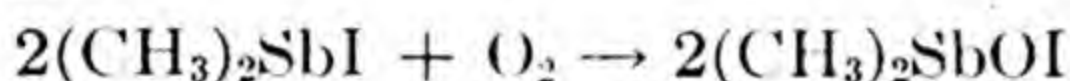


G. T. Morgan and V. E. Yarsley, *Proc. Roy. Soc. (London)*, **110A**, 536 (1926) 110

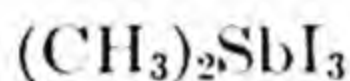
 O_2

I-681

Slow oxidation of dimethylstibine iodide with air forms pale yellow, amorphous dimethyl antimonyl iodide. The compound is slightly soluble in hot water and slowly hydrolyzes by warm solutions to dimethylstibinic acid.

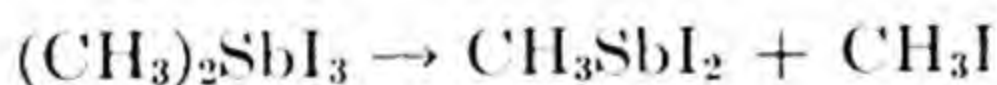


G. T. Morgan and G. R. Davies, *Proc. Roy. Soc. (London)*, **110A**, 532 (1926) 110

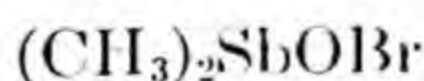
 Δ

I-682

Dimethyl antimony triiodide spontaneously decomposes to methylstibine diiodide which crystallizes from carbon disulfide in rosettes of bright yellow needles melting at 110° . The compound is stable in air but hydrolyzes very slowly in hot water. It is very soluble in hot carbon disulfide, ether or benzene and sparingly soluble in light petroleum.

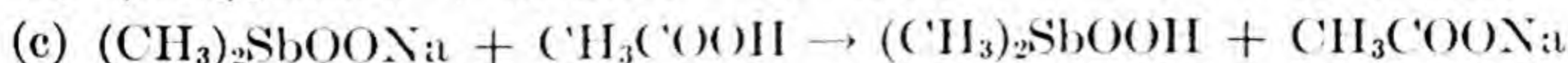
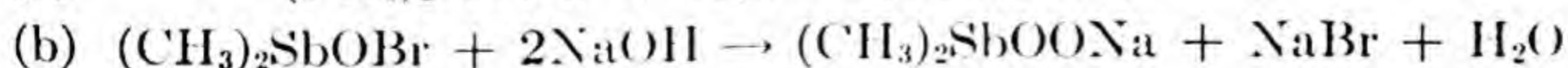
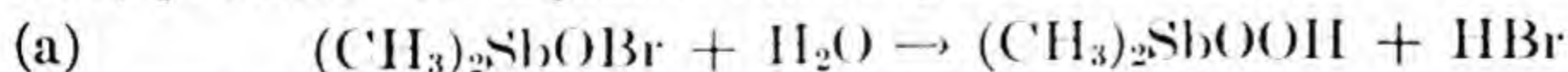


G. T. Morgan and G. R. Davies, *Proc. Roy. Soc. (London)*, **110A**, 533 (1926) 110

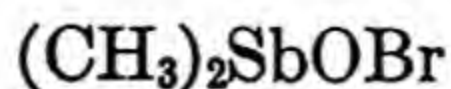
 H_2O

I-683

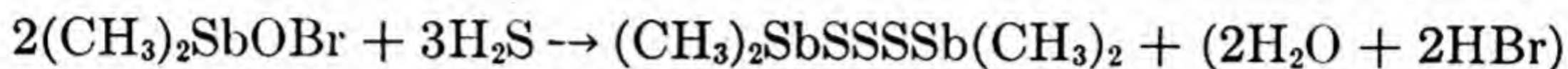
Prolonged boiling of dimethyl antimonyl bromide with water, or reaction with sodium hydroxide solution followed by acidification with acetic acid, produces amorphous dimethylstibinic acid.



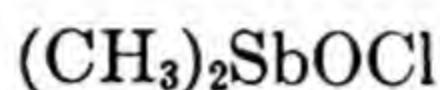
G. T. Morgan and G. R. Davies, *Proc. Roy. Soc. (London)*, **110A**, 530 (1926) 110

**H₂S****I-684**

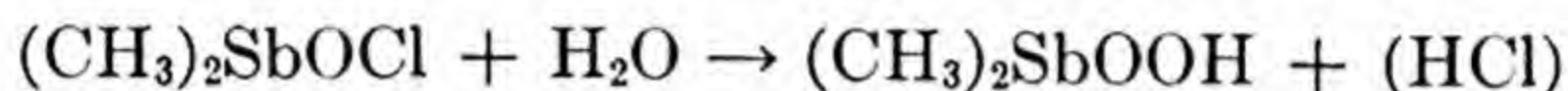
Hydrogen sulfide is rapidly passed into a suspension of dimethyl antimonyl bromide in water, forming a light yellow precipitate which is partly soluble in carbon disulfide. The soluble fraction recovered from the carbon disulfide is bisdimethyl antimony trisulfide, m. 76–78°.



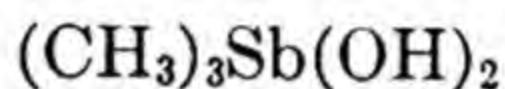
G. T. Morgan and G. R. Davies, *Proc. Roy. Soc. (London)*, **110A**, 531 (1926) 110

**H₂O****I-685**

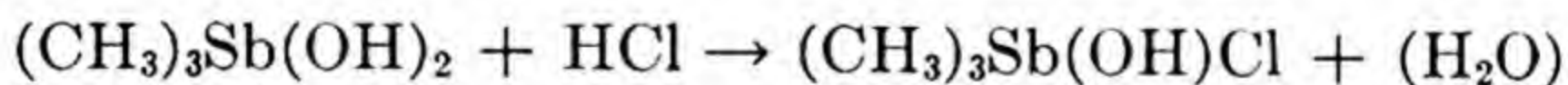
When dimethyl stibine oxychloride is boiled in water for over 8 hours, it is converted into amorphous dimethyl stibinic acid.



G. T. Morgan and G. R. Davies, *Proc. Roy. Soc. (London)*, **110A**, 525 (1926) 110

**HCl****I-686**

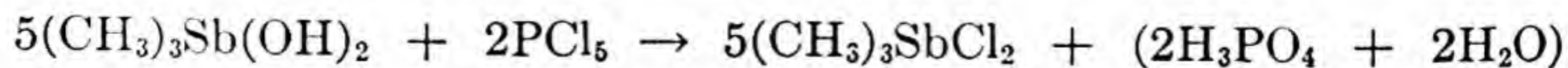
Trimethyl antimony hydroxochloride is precipitated as a white, flocculent mass on adding concentrated hydrochloric acid to an aqueous solution of trimethyl antimony dihydroxide. The hydrochloride is soluble in water and crystallizes from ether in plates and from alcohol in silky needles.



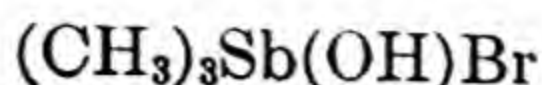
G. T. Morgan and V. E. Yarsley, *Proc. Roy. Soc. (London)*, **110A**, 537 (1926) 110

**PCl₅****I-687**

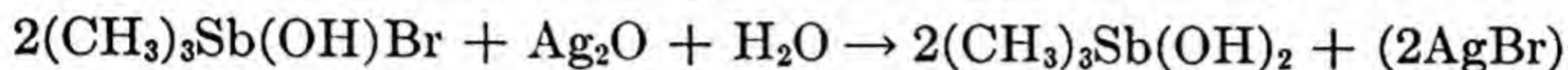
When trimethyl antimony dihydroxide is gently warmed with phosphorus pentachloride in slight excess, trimethyl antimony dichloride is obtained in well defined, colorless needles.



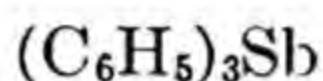
G. T. Morgan and V. E. Yarsley, *Proc. Roy. Soc. (London)*, **110A**, 537 (1926) 110

**Ag₂O****I-688****H₂O**

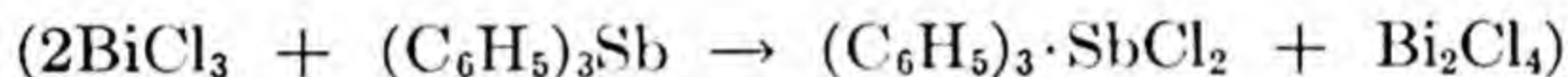
Trimethyl antimony dihydroxide is prepared by warming 2 g. of trimethyl antimony hydroxobromide with 1 g. of silver oxide in 10 ml. of water on a water bath and filtering. The product separates from the filtrate in colorless, microscopic, slightly hygroscopic crystals. The compound forms a pale yellow precipitate with aqueous picric acid.



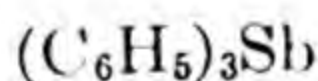
G. T. Morgan and V. E. Yarsley, *Proc. Roy. Soc. (London)*, **110A**, 536 (1926) 110

**BiCl₃****I-689**

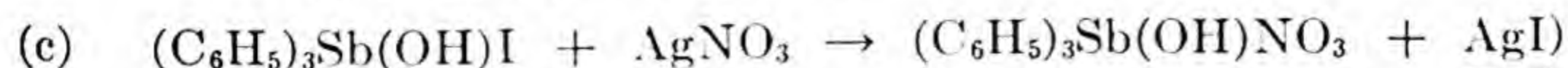
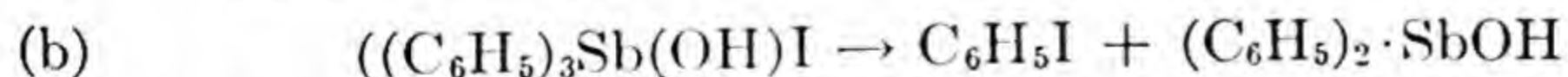
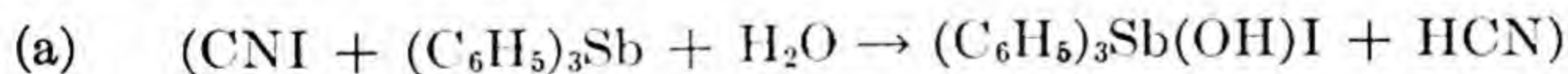
Bismuth trichloride (1 mole) is slowly added to triphenyl stibine (1 mole), both in dry ether. A yellow precipitate containing inorganic compounds of bismuth and arsenic is formed. After decanting and evaporating the ether, the latter is found to contain triphenyl antimony dichloride. Bismuth dichloride is probably among the inorganic reaction products.



Frederick Challenger and Leslie R. Ridgway, *J. Chem. Soc. (London)*, **121**, 115, 116 (1922) 48

**CNI****I-690**

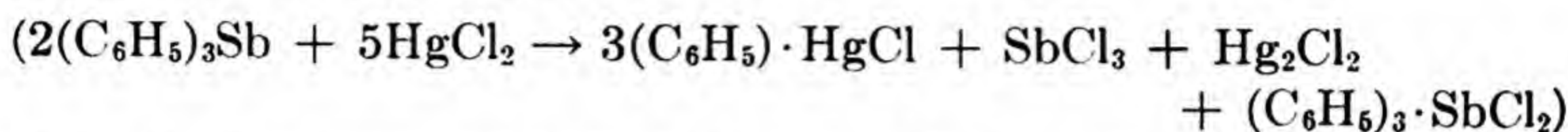
Triphenyl stibine reacts with cyanogen iodide in ordinary ether, giving triphenyl antimony hydroxyiodide in form of a white precipitate turning yellowish brown, (a). Upon heating, this substance liberates iodo-benzene, (b). With alcoholic silver nitrate, triphenyl-antimony-hydroxynitrate is formed, (c).



John F. Wilkinson and Frederick F. Challenger, *J. Chem. Soc.*, **125**, 860 (1924) 48

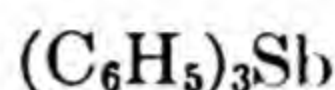
**HgCl₂****I-691**

Triphenyl stibine and alcoholic mercuric chloride react to form mercury-phenyl chloride, antimony trichloride, mercurous chloride and triphenyl stibine dichloride.

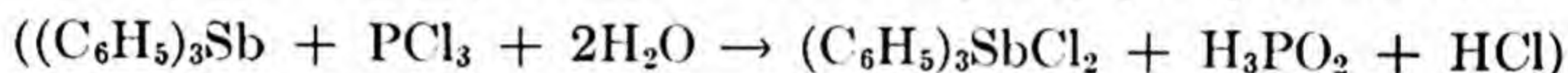


Frederick Challenger and Leslie R. Ridgway, *J. Chem. Soc.*, **121**, 106 (1922)

48

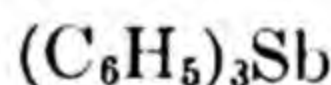
**PCl₃****I-692**

Triphenyl stibine (10 grams), when treated with phosphorus trichloride (4 grams) in light petroleum, yields triphenylantimony dichloride. The mother liquor consists chiefly of hypophosphorous acid, but there are traces of antimony oxychloride and of halogen derivatives of tervalent antimony. With ferric chloride, the solution becomes slightly turbid, indicating the presence of traces of phenylphosphinous acid.

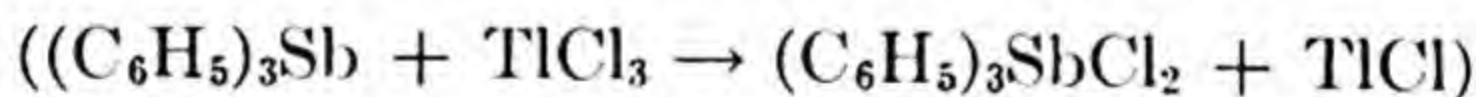


Frederick Challenger and Freda Pritchard, *J. Chem. Soc.*, (London), **125:1**, 870 (1924)

48

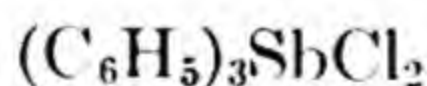
**TlCl₃****I-693**

When triphenyl stibine is treated with thallic chloride, triphenyl stibine dichloride and thallic chloride are obtained.

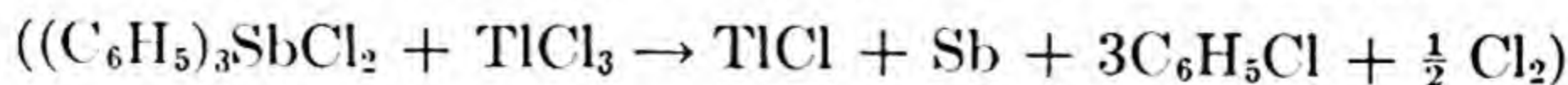


A. E. Goddard and Dorothy Goddard, *J. Chem. Soc.*, **121**, 483 (1922)

48

**TlCl₃****I-694**

3.5 gr. of triphenyl antimony dichloride and 3 gr. of thallium trichloride are boiled in xylene for two hours. After standing for a week, a residue of thallium monochloride is filtered off. After six months standing, metallic antimony is obtained in form of shining plates. Unchanged triphenyl antimony dichloride is also present in this residue.

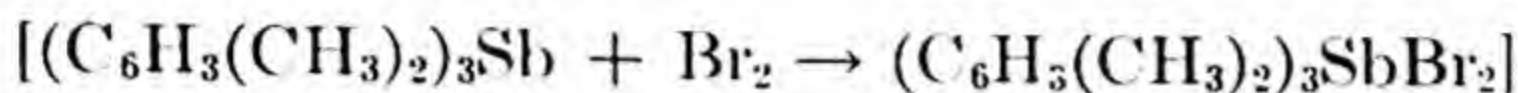


Archibald E. Goddard, *J. Chem. Soc.*, **123**, 1161 (1923)

48

**Br₂****I-695**

To 2 grams of tri-m-xylyl stibene in 5 cc. of chloroform, bromine is added until the solution is just colored. On evaporation, tri-m-xylyl-antimony dibromide is obtained.

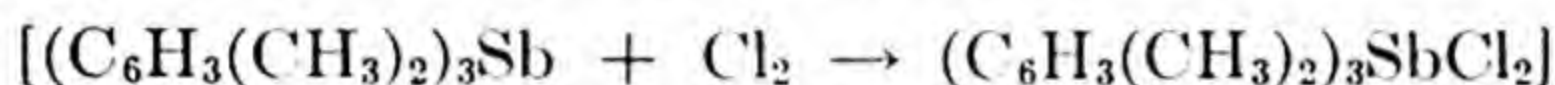


Archibald E. Goddard, J. Chem. Soc., **123**, 2320 (1923)

48

**Cl₂****I-696**

A chloroform solution of tri-m-xylyl stibine is saturated with chlorine and allowed to evaporate spontaneously; small white granular crystals of tri-m-xylyl antimony dichloride are formed.

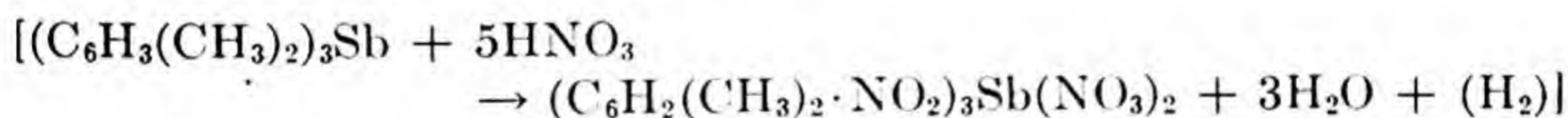


Archibald E. Goddard, J. Chem. Soc., **123**, 2319 (1923)

48

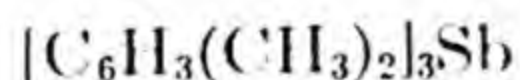
**HNO₃****I-697**

Tri-m-xylyl-stibine is slowly added to nitric acid, complete solution taking place. After warming, the mixture is poured into water and a white flocculent precipitate of tri-5-nitrotri-m-xylyl-antimony-dinitrate is formed. The product can be obtained in crystalline form after repeated crystallizations from alcohol.

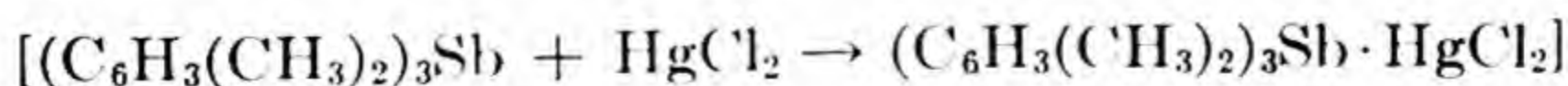


Archibald E. Goddard, J. Chem. Soc., **123**, 2320 (1923)

48

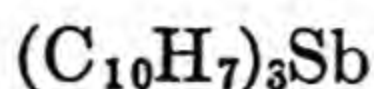
**HgCl₂****I-698**

Tri-m-xylyl stibine in absolute alcohol is added to mercuric chloride in the same solvent. By slow evaporation of the mixture, tri-m-xylyl antimony mercurichloride is obtained. When recrystallized from ether, this compound can be obtained in form of fine needles.



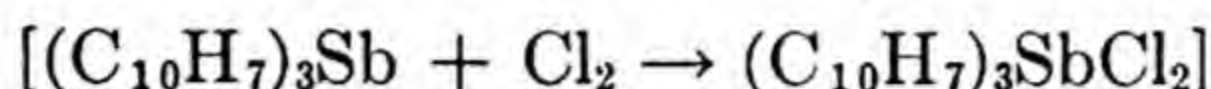
Archibald E. Goddard, J. Chem. Soc., **123**, 2320 (1923)

48

 Cl_2

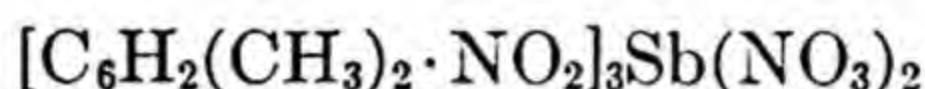
I-699

By adding 2 grams of solid tri- α -naphthyl stibine to a solution of 0.3 gram of chlorine in carbon tetrachloride and diluting this mixture with light petroleum, the dichloride of tri- α -naphthyl stibine is obtained. The dibromide is obtained in the same way.



F. Challenger and Freda Pritchard, *J. Chem. Soc.*, **125**, 869 (1924)

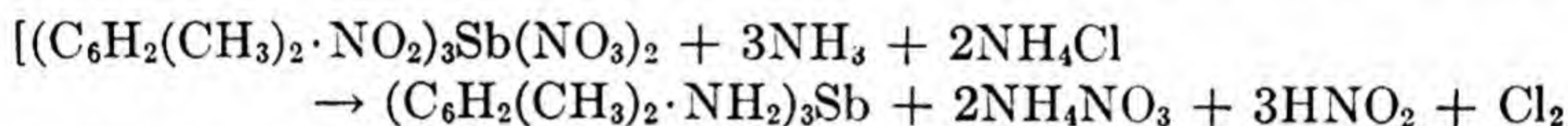
48

 NH_3

I-700

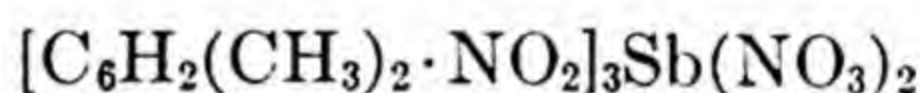
 NH_4Cl

Tri-5-nitro-tri-m-xylylantimony dinitrate is added to boiling alcohol containing ammonium chloride, ammonia and zinc. After prolonged heating, filtering, etc., crude tri-5-aminotri-m-xylyl stibine is obtained.



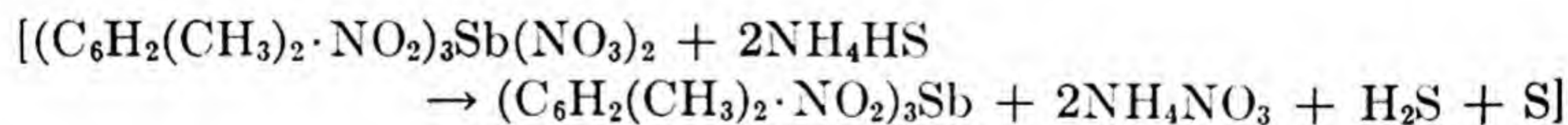
Archibald E. Goddard, *J. Chem. Soc.*, **123**, 2321 (1923)

48

 NH_4HS

I-701

If through a boiling alcoholic solution of tri-5-nitrotri-m-xylyl antimony dinitrate a stream of hydrogen sulfide is passed in presence of concentrated ammonia, a precipitate of tri-5-nitrotri-m-xylyl stibine will be obtained on cooling.



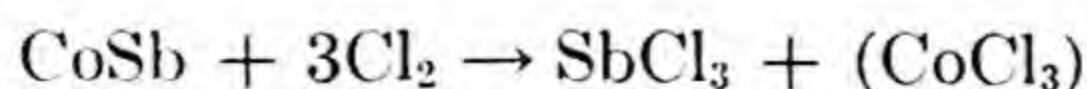
Archibald E. Goddard, *J. Chem. Soc.*, **123**, 2320 (1923)

48

 Cl_2

I-702

When cobalt antimonide is heated with chlorine, a strongly exothermic reaction takes place and antimony trichloride distills over.



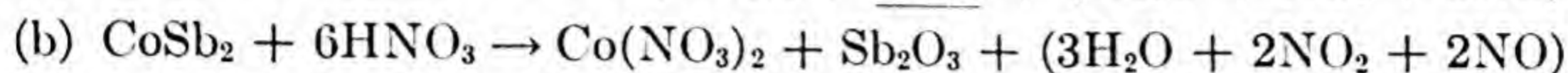
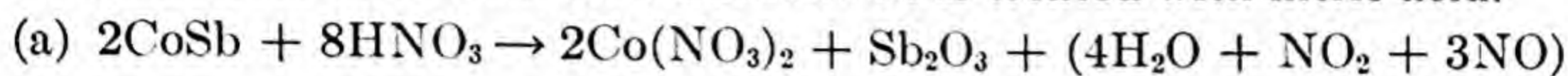
E. Ducelliez, *Compt. rend.*, **147**, 1050 (1908)

38

CoSb

HNO₃**I-703**

Dilute or concentrated nitric acid rapidly dissolves the cobalt in cobalt antimonide and leaves a deposit of antimony trioxide. The same type reaction occurs when cobalt diantimonide is treated with nitric acid.



F. Ducelliez, *Compt. rend.*, **147**, 1050 (1908)

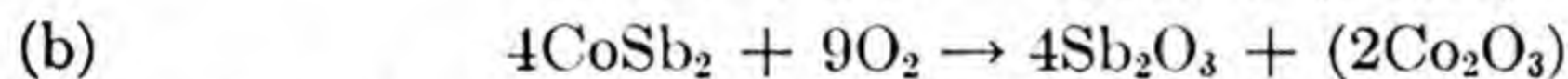
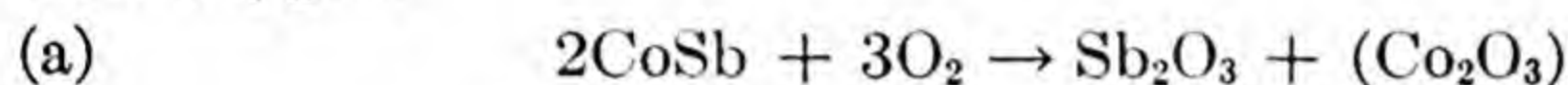
38

CoSb

O₂**I-704**

Cobalt antimonide burns, when heated with oxygen, evolving vapors of antimony trioxide.

The same products are obtained when cobalt diantimonide is heated with oxygen.

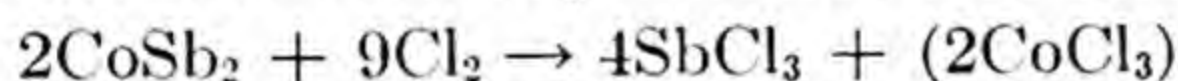


F. Ducelliez, *Compt. rend.*, **147**, 1050 (1908)

38

CoSb₂**Cl₂****I-705**

When cobalt diantimonide is heated with chlorine, a strongly exothermic reaction takes place and antimony trichloride distills over.

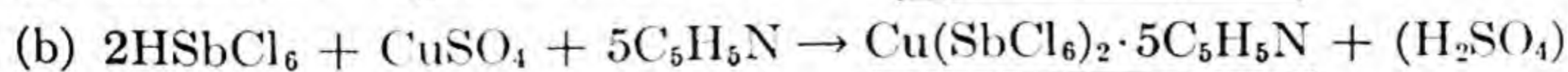
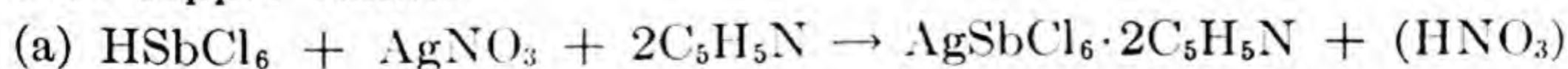


F. Ducelliez, *Compt. rend.*, **147**, 1050 (1908)

38

HSbCl₆**C₅H₅N****I-706****AgNO₃****CuSO₄**

A solution of metachloro antimonie acid in 80% alcohol will react with a concentrated solution of silver nitrate to which alcohol and pyridine has been added. The resulting precipitate of yellow color is silver metachloroantimoniate didipyridine. The same type reaction occurs with copper sulfate.



R. F. Weinland and H. Schmid, *Z. anorg. Chem.*, **44**, 37 (1905)

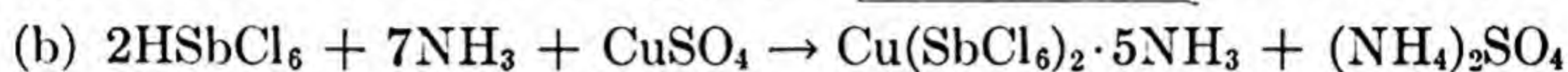
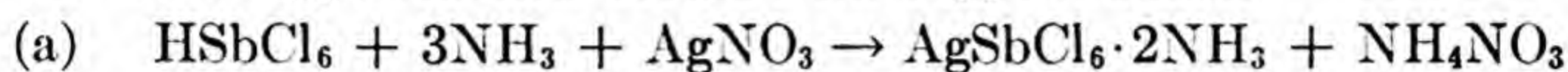
28



I-707



Ammonia and silver nitrate solution are added to a freshly prepared solution of metachloro antimonie acid; a crystalline precipitate of yellow color, silver metachloro antimoniate-diammoniate is obtained. The same type reaction occurs with copper sulfate.

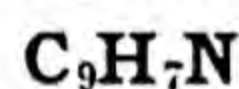
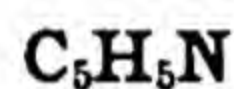


R. F. Weinland and H. Schmid, Z. anorg. Chem., **44**, 37 (1905)

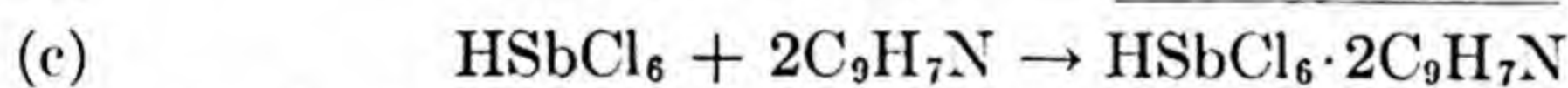
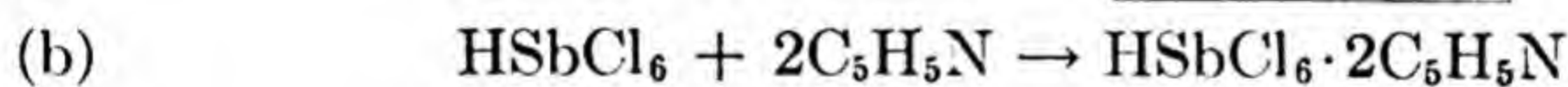
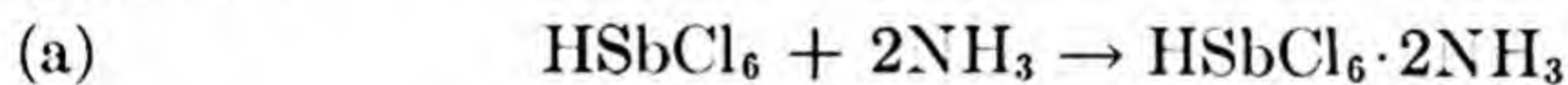
28



I-708



A freshly prepared solution of metachloro antimonie acid will react with an excess of ammonia yielding basic metachloro antimonie acid-diammoniate. The same type reaction occurs with pyridine and quinoline.

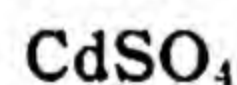


R. F. Weinland and H. Schmid, Z. anorg. Chem., **44**, 37 (1905)

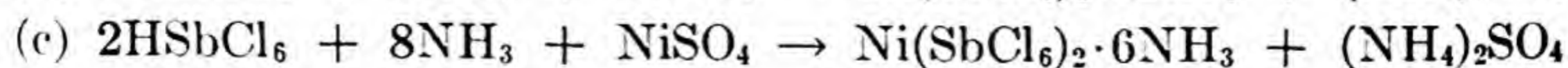
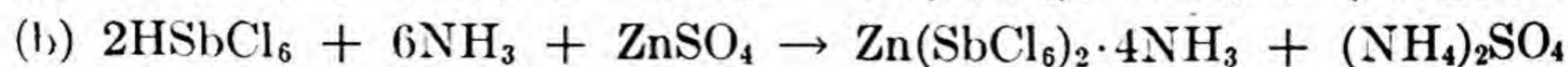
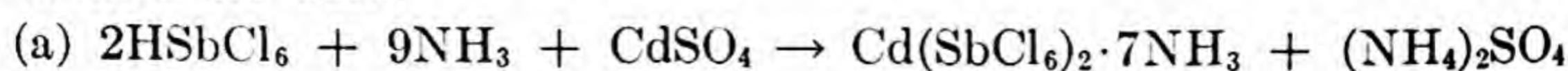
28



I-709

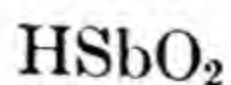


Ammonia and cadmium sulfate solution are added to a freshly prepared solution of metachloro antimonie acid. A crystalline precipitate of yellow color, cadmium metachloro antimoniate heptammoniate is obtained. The same type reaction occurs when zinc sulfate and nickel sulfates are used.

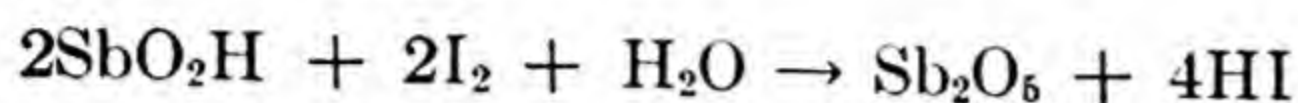


R. F. Weinland and H. Schmid, Z. anorg. Chem., **44**, 37 (1905)

28

**I₂****I-710**

Antimony has been determined quantitatively by means of 0.1 *N* iodine in an alkaline solution. The reaction is carried out in the presence of ammonium sesqui-carbonate.

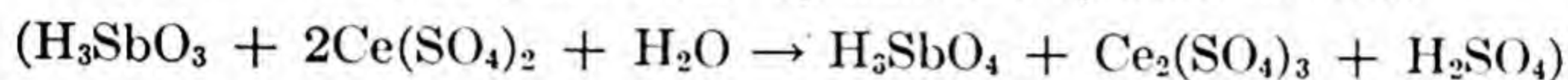


A. Blanchetière, *Bull. Soc. Chim. [IV]*, **27**, 479 (1920)

31

**Ce(SO₄)₂****I-711**

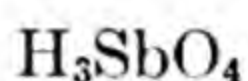
Trivalent antimony is quantitatively oxidized by ceric sulfate.



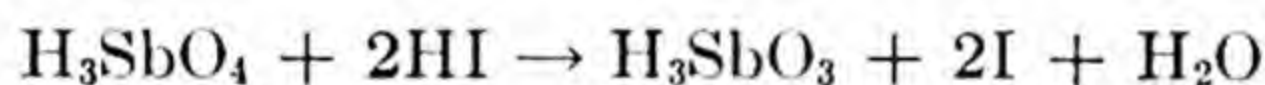
Willard and Young, *J. Am. Chem. Soc.*, **50**, 1376 (1928)

Ref., McNabb and Wagner, *Anal. Ed.*, **2**, 251 (1930)

33

**HI****I-712**

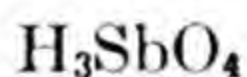
Pentavalent antimony is reduced in the cold by hydriodic acid, iodine being liberated.



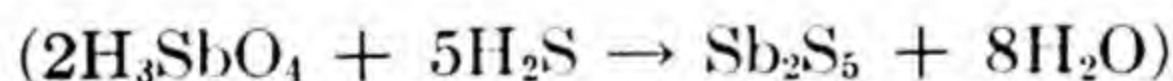
Scott, "Standard Methods of Chemical Analysis," P. 25 (1922)

Ref., McNabb and Wagner, *Anal. Ed.*, **2**, 251 (1930)

33

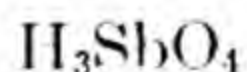
**H₂S****I-713**

If an aqueous solution of hydrogen sulfide is added to a completely oxidized solution of orthoantimonic acid antimony pentasulfide is precipitated.



Otto Bosc, *J. Chem. Soc. (London)*, **67**, 519 (1895)

103

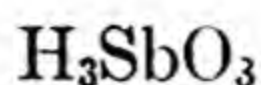
**Hg****I-714**

Antimonic acid is reduced to antimonous on shaking violently for five minutes with mercury, its solution containing one-fourth or one-third its volume of concentrated hydrochloric acid (sp. gr. 1.19). Owing to the air present, a small amount of mercuric chloride is also formed.



McCoy, *Ind. Eng. Chem., Anal. Ed.*, **5**, 1 (1933)

33



I

I-715

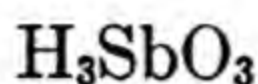
Trivalent antimony is oxidized by iodine.



Mohr, "Lehrbuch der Titrimethode", p. 261 (1862)

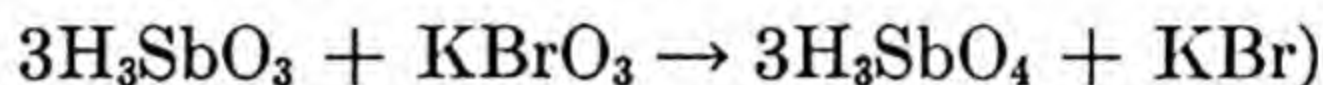
Ref., McNabb and Wagner, Ind. Eng. Chem., Anal. Ed., **2**, 251 (1930)

33

KBrO₃

I-716

Trivalent antimony is oxidized by potassium bromate in hydrochloric acid solution at room temperature.



St. Györy, Z. Anal. Chem., **32**, 415 (1893)

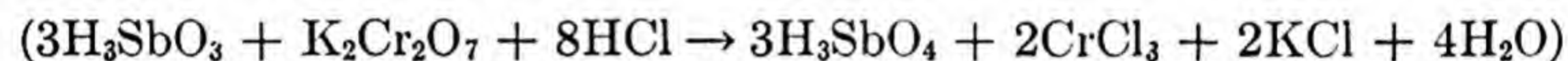
Ref., McNabb and Wagner, Ind. Eng. Chem., Anal. Ed., **2**, 251 (1930)

33

K₂Cr₂O₇

I-717

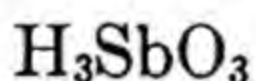
Trivalent antimony can be quantitatively oxidized by dichromate using diphenylamine as indicator.



Knop, Z. Anal. Chem., **63**, 96 (1923)

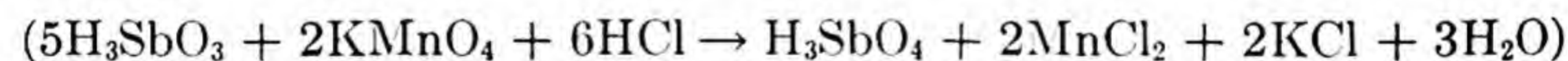
Ref., McNabb and Wagner, Ind. Eng. Chem., Anal. Ed., **2**, 251 (1930)

33

KMnO₄

I-718

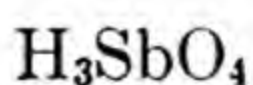
Trivalent antimony is oxidized by permanganate in hydrochloric acid solution.



Kessler, Z. Anal. Chem., **2**, 386 (1863)

Ref., McNabb and Wagner, Ind. Eng. Chem., Anal. Ed., **2**, 251 (1930)

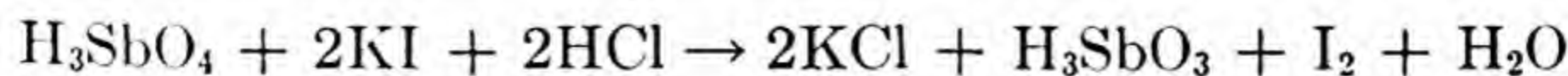
33



KI

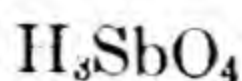
I-719

Antimonic acid oxidizes potassium iodide releasing free iodine by this reaction in the presence of hydrochloric acid.

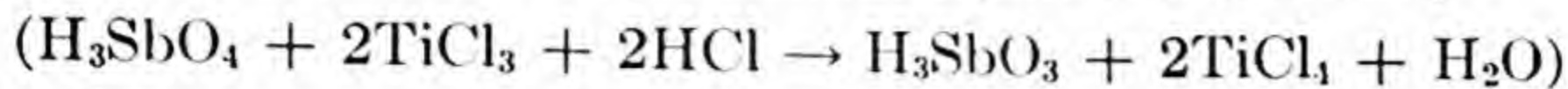


Demorest, J. Ind. Eng. Chem., **2**, 80 (1910)

22

TiCl₃**I-720**

Pentavalent antimony can be quantitatively reduced by titanous chloride, the end point being determined potentiometrically.



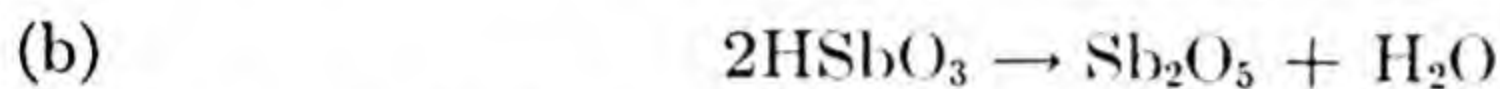
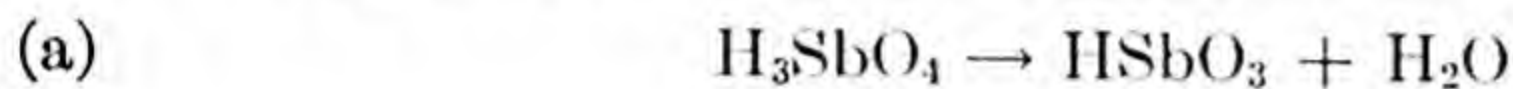
Koltoff, "Volumetric Analysis", **2**, 305, 410, 464, (1929)

Ref., McNabb and Wagner, Anal. Ed., **2**, 251 (1930)

33

Δ**I-721**

Antimony pentoxide is formed when antimonie acid is heated at 275°C.



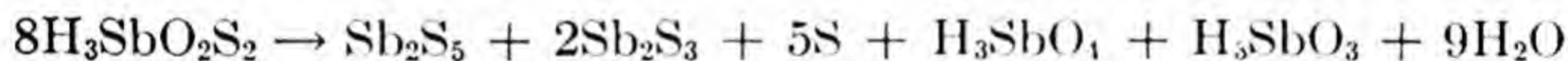
Geuther, J. prakt. Chem., **4**, 438 (1820)

Ref., Ann., **186**, 111 (1877)

1

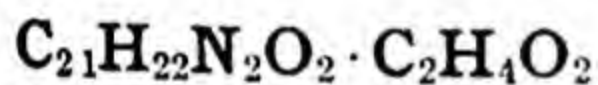
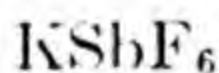
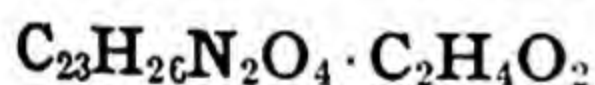
H₂O**I-722**

Dithio antimonie acid decomposes with water yielding a variety of products.

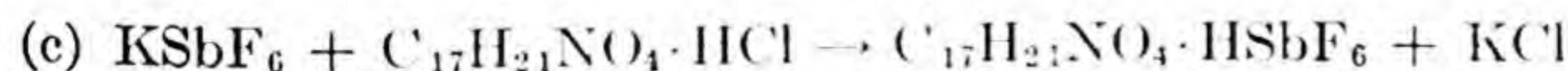
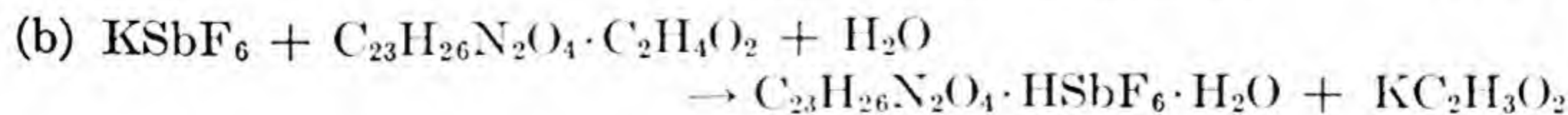
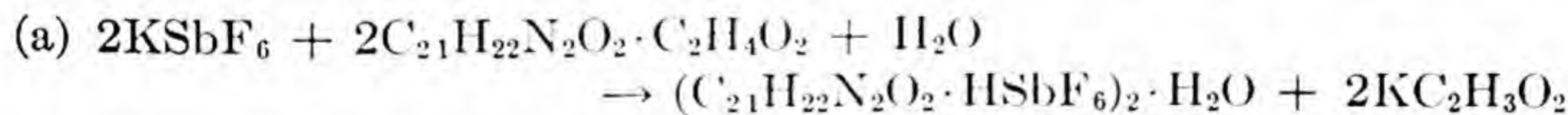


McCay: Am. Chem. J., **17**, 778 (1895)

1

**I-723**

A solution of potassium fluoantimonate will react with strychnine acetate yielding crystals of strychnine fluoantimonate. The same type reaction occurs with brucine acetate and cocaine hydrochloride.



W. Lange and K. Askitapoulos, Z. anorg. Chem., **223**, 369 (1935)

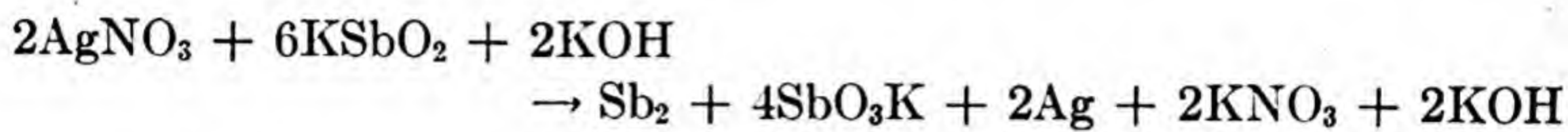
28



I-724



Metallic silver is obtained when silver nitrate reacts with potassium antimonite in alkaline solution.



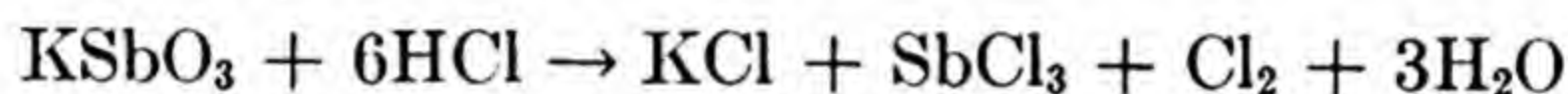
W. Pillitz, Z. anal. Chem., **21**, 27 (1882)

28



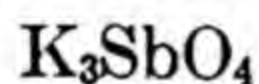
I-725

Potassium metantimonate is energetically attacked by dry hydrogen chloride, heat being liberated.



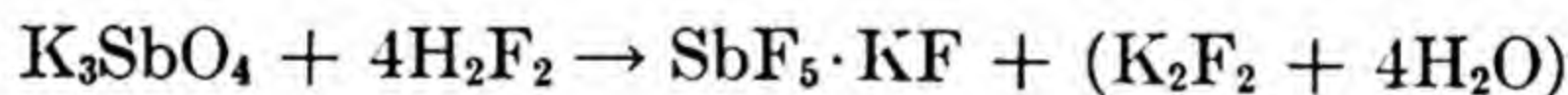
Thomas, J. Chem. Soc., **33**, 372 (1878)

91



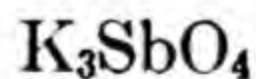
I-726

Very thin rhombic leaves of a double salt are obtained when gummy potassium antimonate is dissolved in hydrofluoric acid.



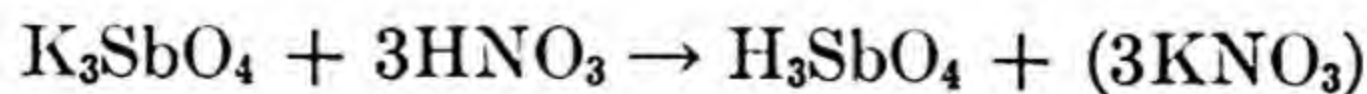
Marignac, Ann., **145**, 243 (1868)

1



I-727

Antimonic acid is formed when potassium antimonate is treated with nitric acid.



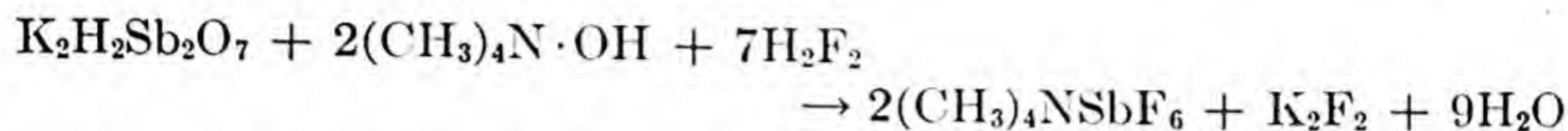
Geuther, J. prakt. Chem., **4**, 438

Ref., Ann., **186**, 111 (1877)

1

(CH₃)₄N·OH**I-728****HF**

A solution of 4 g. of dipotassium dihydrogen pyroantimonate and 2.2 g. of tetramethyl ammonium hydroxide in an excess of 40% hydrofluoric acid is evaporated on the water bath. Crystals of tetramethyl ammonium fluoantimonate are obtained.

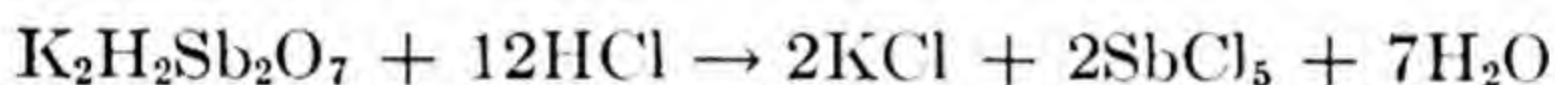


W. Lange and K. Askitopoulos, *Z. anorg. Chem.*, **223**, 369 (1935)

28

**HCl****I-729**

Hydrochloric acid acts on dipotassium dihydrogen pyroantimonate yielding potassium chloride, antimony pentachloride and water.

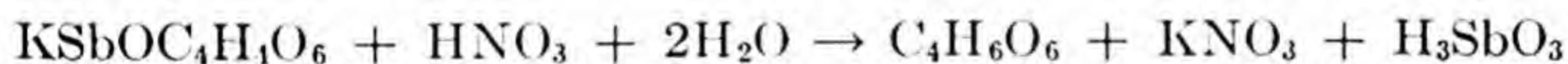


G. K. Bergh, *S. Farm. Tidskr.* **8**, 338 (1904)

10

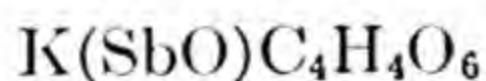
**HNO₃****I-730**

Tartar emetic reacts with nitric acid precipitating antimonious acid.

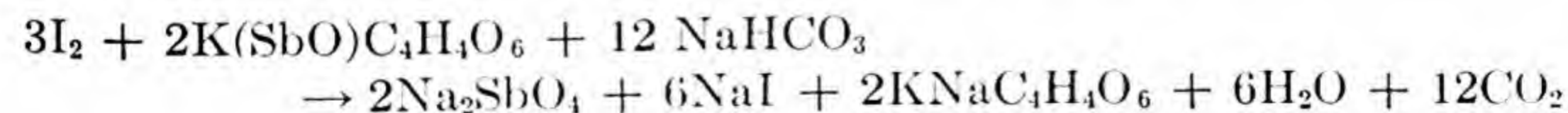


Clarke and Stallo, *J. Am. Chem. Soc.*, **54**, 441 (1932)

1

**I₂****I-731****NaHCO₃**

The iodometric titration of tartar emetic is a well known analytical procedure in which the following reaction is involved.



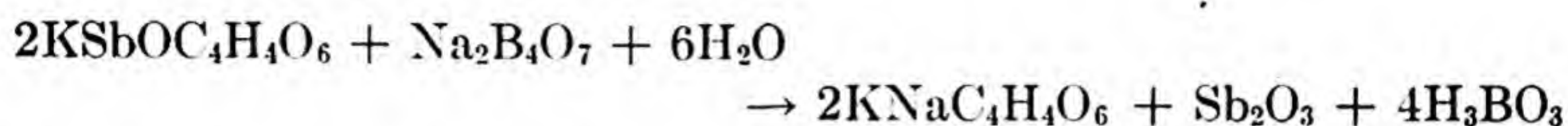
Donald Starr, *Ind. Eng. Chem., Anal. Ed.*, **11**, 519 (1939)

44



I-732

Antimony trioxide precipitates when solutions of borax and tartar emetic are mixed and allowed to stand.



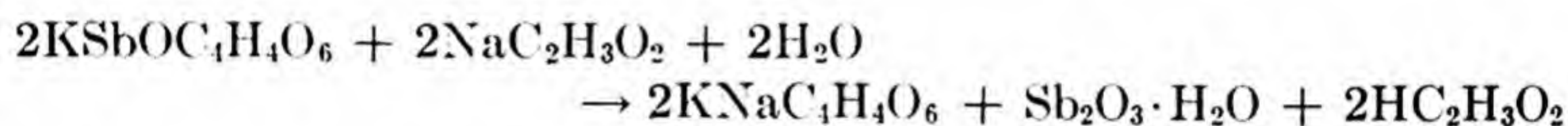
J. H. Long, J. Am. Chem. Soc., **17**, 92 (1895)

1



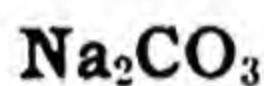
I-733

Hydrated antimony oxide is precipitated when either hot or cold solution of sodium acetate and tartar emetic is mixed and allowed to stand.



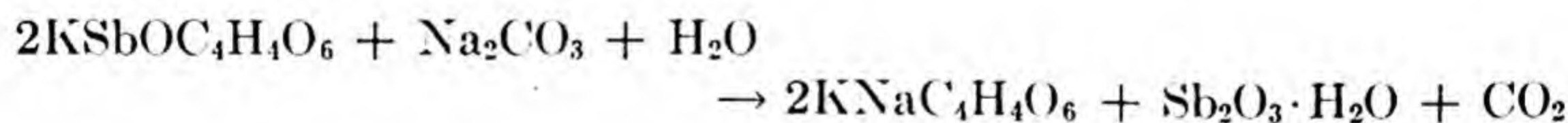
J. H. Long, J. Am. Chem. Soc., **17**, 89 (1895)

1



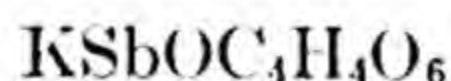
I-734

Hydrated antimony trioxide is formed along with the evolution of carbon dioxide when hot solutions of tartar emetic and sodium carbonate are mixed.



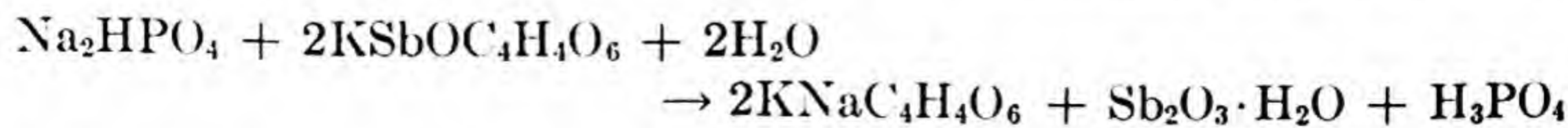
J. H. Long, J. Am. Chem. Soc., **17**, 88 (1895)

1



I-735

Hydrated antimony oxide is precipitated when solutions of disodium acid orthophosphate and tartar emetic are mixed and allowed to stand.



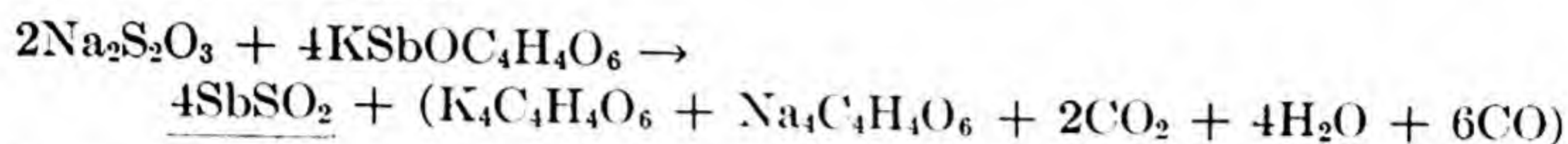
J. H. Long, J. Am. Chem. Soc., **17**, 89 (1895)

1



I-736

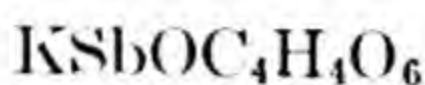
A bright red precipitate is formed when a cold solution of potassium antimonyl tartrate is added to a cold solution of sodium thiosulfate and the mixture boiled.



Pharm. Post., **33**, 233 (1900)

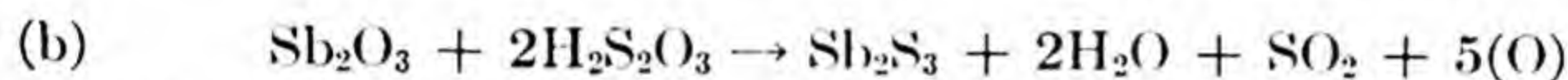
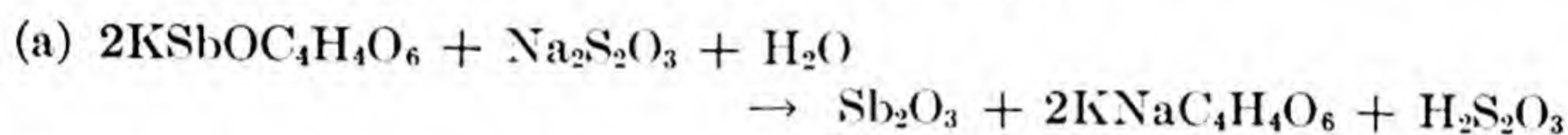
Ref., J. Chem. Soc. (London), **78**, 598 (1900)

1



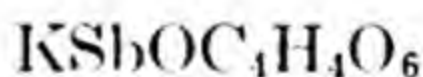
I-737

A precipitate of antimony trisulfide is formed when solutions of sodium thiosulfate and tartar emetic are mixed and allowed to stand. (Reaction varies with conditions of conc. and temp.).



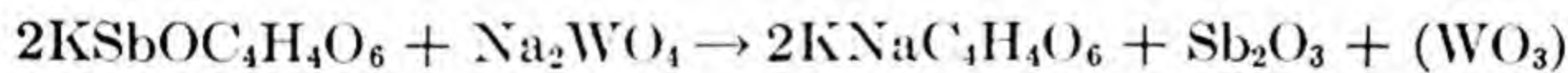
J. H. Long, J. Am. Chem. Soc., **17**, 102 (1895)

1



I-738

Antimony trioxide is precipitated when solutions of sodium tungstate and tartar emetic are mixed and allowed to stand.



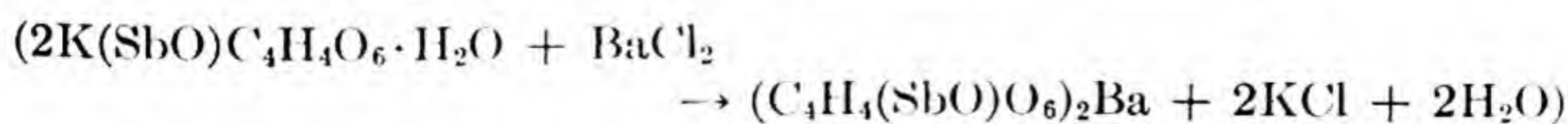
J. H. Long, J. Am. Chem. Soc., **17**, 98 (1895)

1



I-739

If solutions containing equivalent amounts of tartar emetic and barium chloride be mixed, barium antimonyl tartrate is obtained.



Charles Lea and John K. Wood, J. Chem. Soc., **123**, 261 (1923)

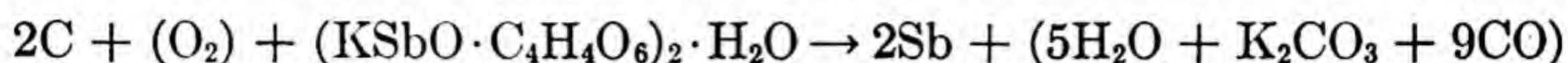
48



C

I-740

Tartar emetic heated with charcoal liberates the element antimony.



H. Brereton Baker, *Trans. Roy. Soc. (London)* **179A**, 571-91 (1889)

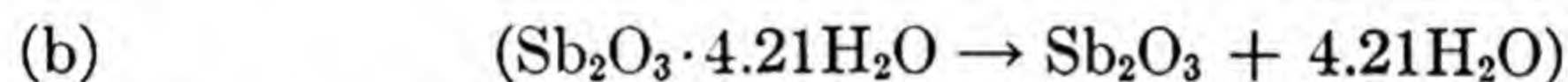
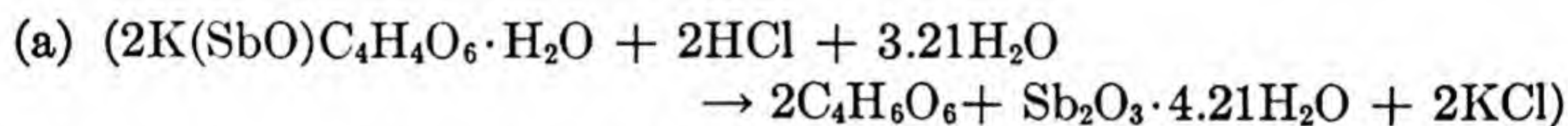
105



HCl

I-741

When hydrochloric acid is added to a solution of tartar emetic, a white precipitate of the hydrated antimonious oxide shown in (a) is formed. When standing in contact with a large volume of water for 6 months, the oxide is dehydrated, and anhydrous antimonious oxide in the form of octahedral crystals is obtained, (b).



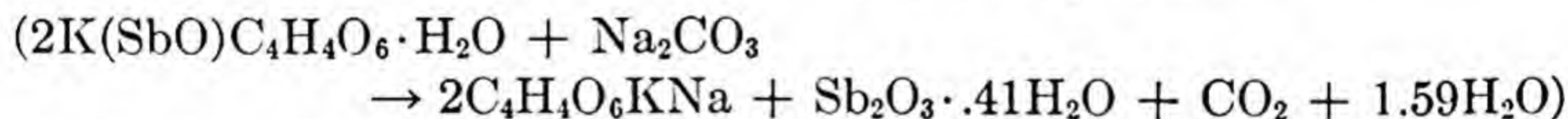
Charles Lea and John K. Wood, *J. Chem. Soc.*, **123:1**, 261 (1923)

48

Na₂CO₃

I-742

When a solution of tartar emetic is treated with a slight excess of sodium carbonate solution, a white precipitate of hydrated antimonious oxide is formed. The degree of hydration of this oxide varies with the temperature of precipitation: at 100°, the oxide contains 0.09 molecule of water, whereas at 0° 0.41 molecule of water is present.



Charles Lea and John K. Wood, *J. Chem. Soc.*, **123:1**, 261 (1923)

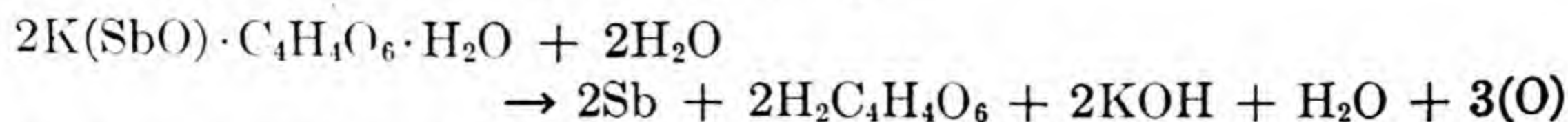
48



€

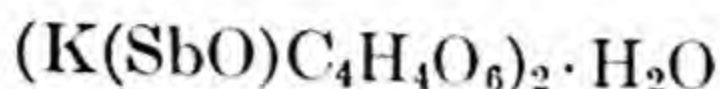
I-743

A solution of tartar emetic was electrolyzed in the presence of excess tartaric acid, using a mercury cathode. The crystalline variety of antimony deposited and formed an amalgam.



G. Gore, *Trans. Roy Soc. (London)*, **149**, 807 (1860)

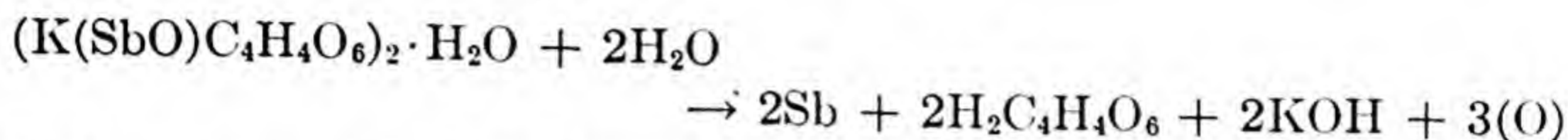
105



€

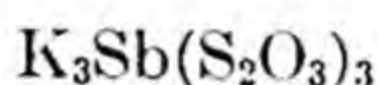
I-744

A solution of five parts tartar emetic, five parts tartaric acid, two parts hydrochloric acid, and thirty parts water produces gray crystalline antimony when electrolyzed.



G. Gore, Trans. Roy. Soc. (London), **148**, 185 (1859)

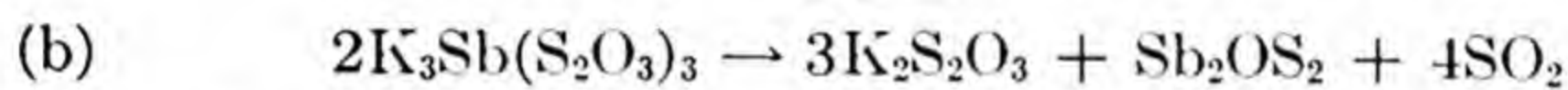
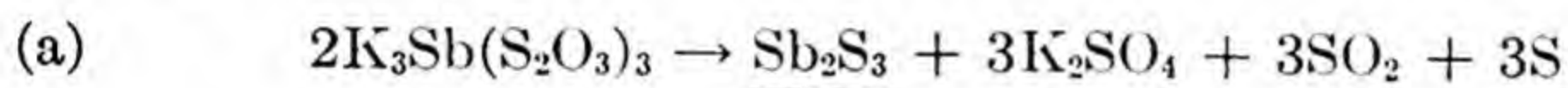
105



Δ

I-745

An orange-red compound is formed when potassium antimony thiosulfate solution is boiled. Corresponding products are formed when sodium antimony thiosulfate is heated.

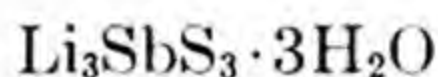


J. v. Szilagyi, Z. anorg. Chem., **113**, 69 (1920)

28

Ref., J. Chem. Soc. (London), **120**, 207 (1921)

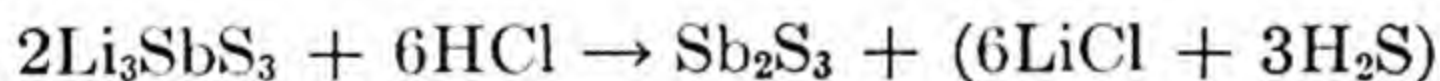
1



HCl

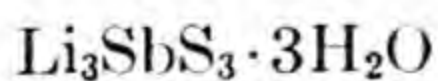
I-746

Acids precipitate antimony trisulfide from a solution of lithium orthothioantimonite.



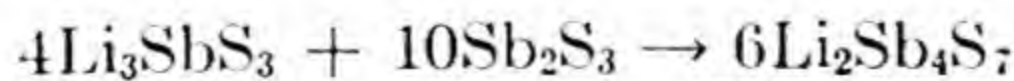
I. Pouget, Ann. Chim. Phys., **18**, [VII], 508 (1899)

2

Sb₂S₃

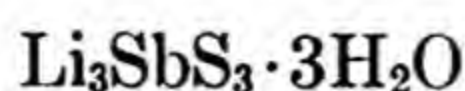
I-747

A solution of lithium orthothioantimonite saturated with antimony sulfide on cooling forms a red gelatinous precipitate of lithium parathioantimonite.



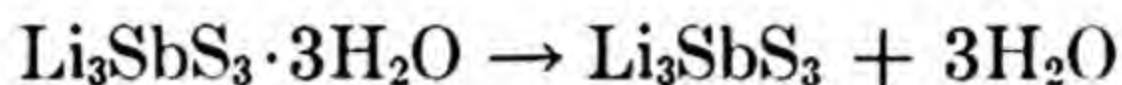
I. Puget, Ann. Chim. Phys., **18**, 508 (1899)

2

 Δ

I-748

Warmed in a current of hydrogen, lithium orthothioantimonite crystals lose the water of crystallization at about 150°.



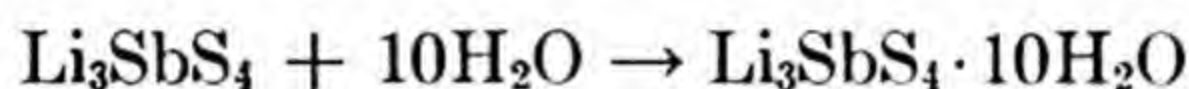
I. Pouget, *Ann. chim. Phys.*, [VII], **18**, 508-571 (1899)

2

 H_2O

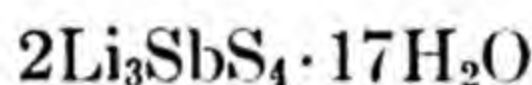
I-749

Lithium thioantimonate reacts with water to form the decahydrate.



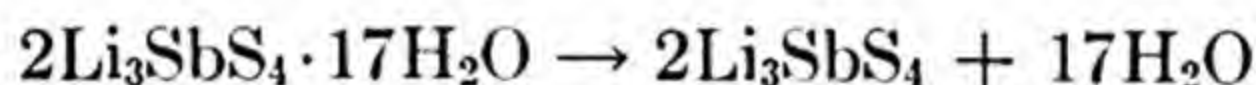
A. D. Donk, *Chem. Weekblad*, **5**, 529-551 (1908)

2

 $\text{C}_2\text{H}_5\text{OH}$

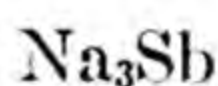
I-750

At 30° alcohol completely dehydrates lithium thioantimonate.



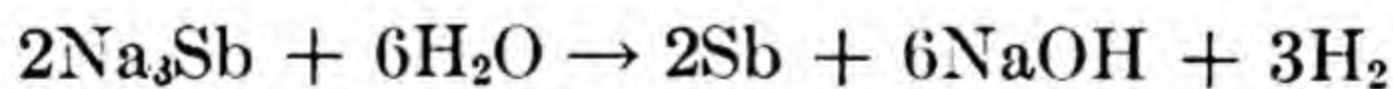
F. A. H. Schreinemakers: *Chem. Weekblad*, **7**, 211-216

2

 H_2O

I-751

Sodium antimonide is decomposed by water yielding metallic antimony.



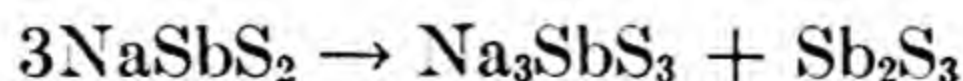
H. Reckleben and J. Scheiber, *Z. anorg. Chem.*, **70**, 275 (1911)

28

 Δ

I-752

Sodium sulfantimonide decomposes into sodium thioantimonite and antimony trisulfide, when heated.



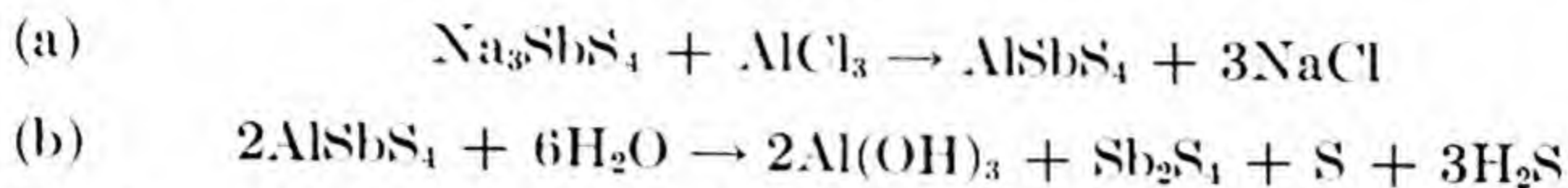
G. F. Bergh, *Sv. Farm. Tidskr.* **8**, 183 (1904)

10

AlCl₃ **I-753**



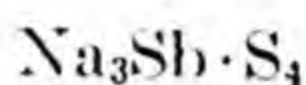
Aluminum chloride in aqueous solution decomposes sodium thioantimonate with the formation of antimony tetrasulfide and sulphur, and the evolution of hydrogen sulfide.



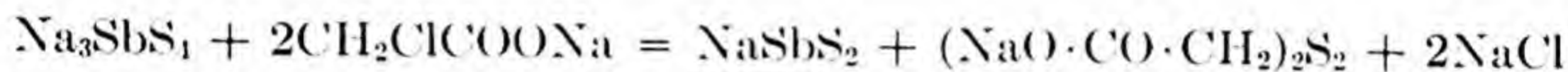
Kirchhoff, Z. anorg. Chem., **122**, 68 (1920)

1

CH₂Cl·COONa **I-754**



A solution of sodium thioantimonate will react with the sodium salt of monochloroacetic acid yielding a precipitate of sodium metathioantimonite.



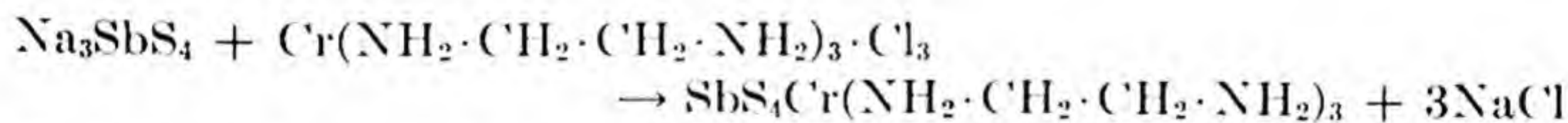
B. Holmberg, Z. anorg. Chem., **56**, 385 (1908)

28

Cr(NH₂·CH₂·CH₂·NH₂)₃Cl₃ **I-755**



Sodium thioantimonate will react with chromium ethylene diamine trichloride yielding yellow crystals.



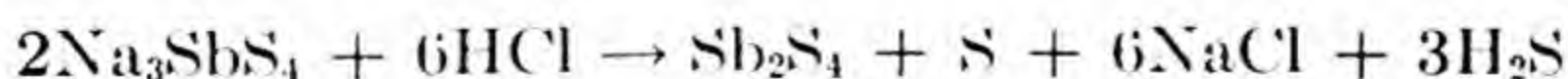
G. Spacu and A. Pop, Z. anal. Chem., **111**, 255 (1937)

28

HCl **I-756**



A tetrasulfide of antimony is formed when sodium thioantimonate is treated with dilute hydrochloric acid.



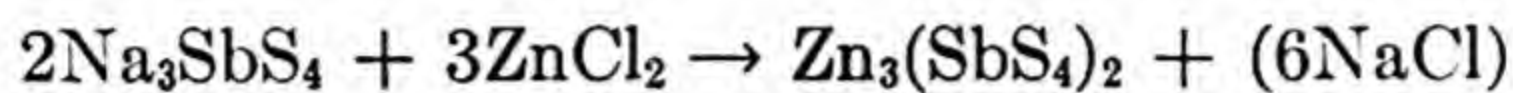
Kirchhoff, Z. anorg. Chem., **112**, 67 (1920)

Ref., J. Chem. Soc. (London), **118**, 693 (1920)

1

**ZnCl₂****I-757**

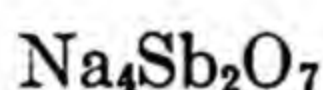
A chrome yellow precipitate of zinc thioantimonate is formed by the interaction of sodium thioantimonate and zinc chloride in wet condition.



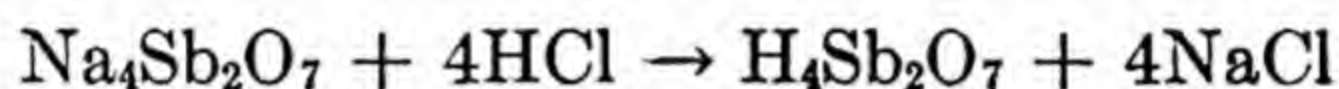
Kirchoff, Z. anorg. Chem., **112**, 67 (1920)

Ref., J. Chem. Soc. (London), **118**, 693 (1920)

1

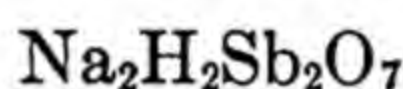
**HCl****I-758**

Sodium pyroantimonate is completely converted into the corresponding acid when heated in a current of hydrogen chloride.

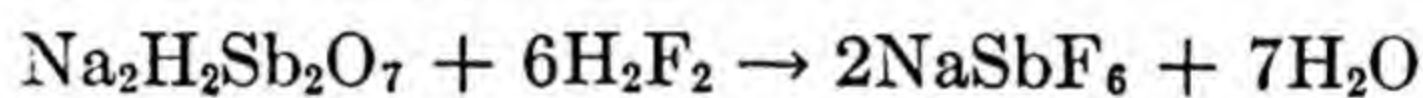


Smith and Hibbs, J. Am. Chem. Soc., **16**, 578 (1895)

1

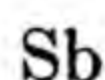
**HF****I-759**

By evaporating a solution of disodium dihydrogen pyroantimonate in an excess of a 40% solution of hydrofluoric acid on the water bath crystals of sodium fluoantimonate are obtained. A similar reaction occurs with dipotassium pyroantimonate.

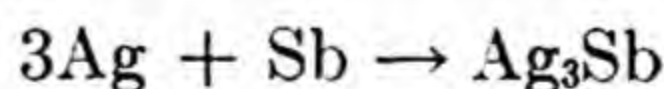


W. Longe and K. Askitopoulos, Z. anorg. Chem., **223**, 369 (1935)

28

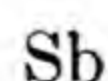
**Ag****I-760**

By cooling a melt composed of three gram atomic weights of silver and one of antimony the compound shown below separates at about 525°C.

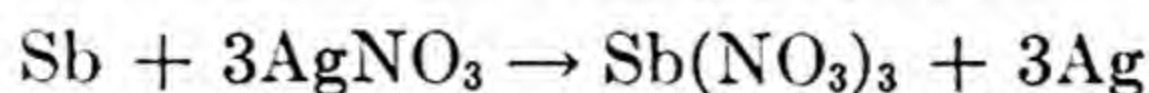


C. T. Heycock and F. H. Neville, Trans. Roy. Soc. (London), **189A**, 25-69 (1897)

105

**AgNO₃****I-761**

Antimony put in silver nitrate solution precipitates silver.



G. Gore, Trans. Roy. Soc. (London), **148**, 194 (1859)

105

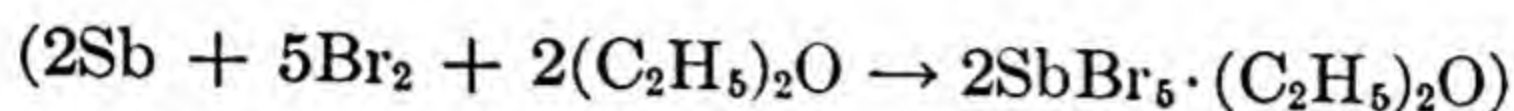
Sb

Br

I-762

 $(C_2H_5)_2O$

Vigorous bromination of powdered antimony in an anhydrous ether solution, using an excess of halogen, yields a crystalline antimony penta-bromide-ether complex.



M. A. Raynaud, Bull. soc. chim. [IV], **27**, 326 (1920)

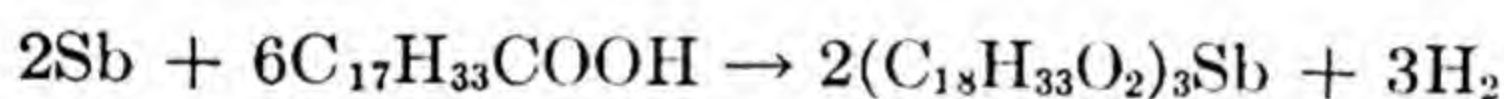
31

Sb

 $C_{18}H_{34}O_2$

I-763

Antimony is corroded by anhydrous oleic acid at temperatures below 100°. Hydrogen is liberated. This reaction is very slow. Anhydrous oleic acid similarly corrodes lead, sodium, potassium, thallium, calcium, magnesium, manganese, zinc, copper, tin, iron, bismuth, mercury, iridium, arsenic, tungsten, tellurium, nickel, cobalt, phosphorus, and sulfur.



C. B. Gates, J. Phys. Chem., **15**, 97 (1911)

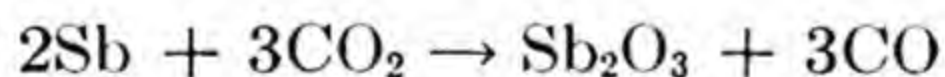
7

Sb

 CO_2

I-764

Antimony trioxide is formed when metallic antimony reacts with carbon dioxide at 1100°.



Bacho, Monatsh. **37**, 117 (1916)

Ref., J. Chem. Soc. (London), **110**, 482 (1916)

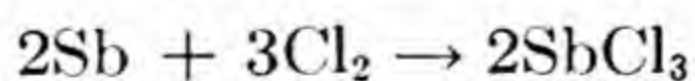
1

Sb

 Cl_2

I-765

Antimony burned in chlorine forms antimony trichloride.



Humphry Davy, Trans. Roy. Soc. (London), **101**, 23 (1811)

105

Sb

Co

I-766

Cobalt combines with antimony to form cobalt antimonide when the two finely divided substances are fused together at 500° in a current of hydrogen, (a). It is possible to form the diantimonide at temperatures above 700°, (b).



F. Ducelliez, *Compt. rend.*, **147**, 1049 (1908)

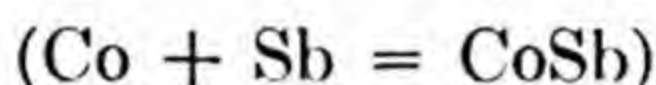
38

Sb

Co

I-767

Cobalt antimonide has been prepared by the action of antimony chloride or antimony vapor on pulverized cobalt.



F. Ducelliez, *Bull. Soc. Chim. [IV]*, **7**, 202 (1910)

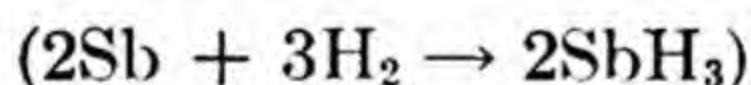
31

Sb

H₂

I-768

Hydrogen liberated from an antimony cathode contains a considerable amount of stibine. This circumstance can be utilized for the preparation and production of stibine.



Newbery, *J. Chem. Soc.*, **109**, 1361 (1916)

Ref., Paneth, *Z. Elektrochem.*, **26**, 453 (1920)

Ref., Henry J. S. Sand, Edward J. Weeks and Stanley W. Worrell, *J. Chem. Soc.*, **123**, 456 (1923)

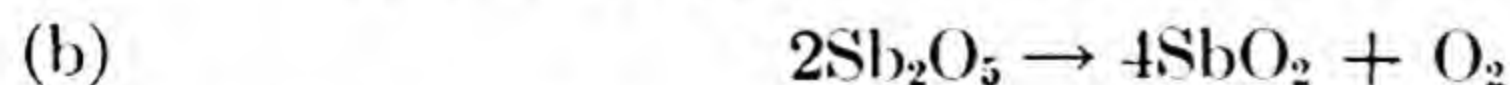
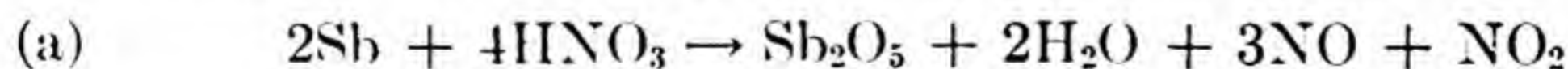
48

Sb

HNO₃

I-769

Antimony dioxide is formed when metallic antimony is oxidized with nitric acid and the resulting oxide heated to dull redness.



Szilagy, *Z. anal. Chem.*, **57**, 23 (1918)

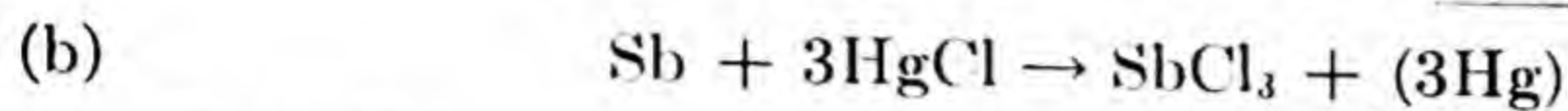
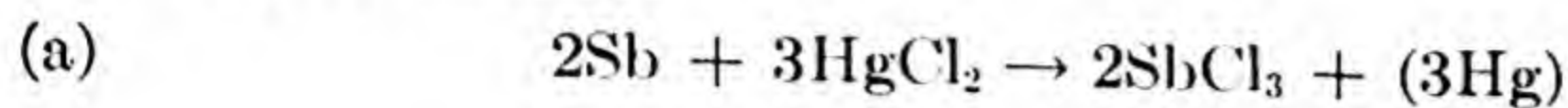
Ref., *J. Chem. Soc. (London)*, **114**, 135 (1918)

1

Sb

HgCl₂**I-770****HgCl**

Antimony heated with either mercuric or mercurous chlorides forms antimony trichloride.



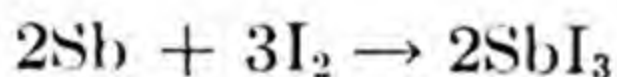
John Davy, *Trans. Roy. Soc., (London)*, **102**, 188 (1812)

105

Sb

I₂**I-771**

Pure powdered antimony is heated with iodine in an atmosphere of carbon dioxide. The product is repeatedly distilled over antimony and, finally, sublimed in a stream of carbon dioxide to yield light red crystals of antimony triiodide.



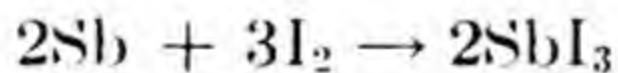
V. Izbekov and A. Nijnik, *J. Gen. Chem. (USSR)*, **7**, 1268 (1937)

60

Sb

I₂**I-772**

Antimony triiodide is made by shaking a solution of iodine in carbon disulfide with an excess of antimony for several hours until the color of the iodine is discharged.



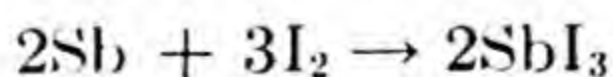
C. B. Allsopp, *Proc. Roy. Soc. (London)*, **158A**, 171 (1937)

110

Sb

I₂**I-773**

A mixture of antimony and iodine is heated gently and the product, antimony triiodide, is obtained through sublimation.



McIvor,

Ref., *R. Gerstl, Ber.*, **8**, 1466 (1875)

26

Sb

KNO₃**I-774**

Antimony put into fused potassium nitrate burns and forms potassium pyroantimonate.



G. Gore, Trans. Roy. Soc. (London), **148**, 197 (1859)

105

Sb

KNO₃ + KHSO₄**I-775**

Shining needle-like crystals of antimony trioxide are obtained when a mixture of potassium nitrate, potassium hydrogen sulfate and powdered antimony is heated to redness.



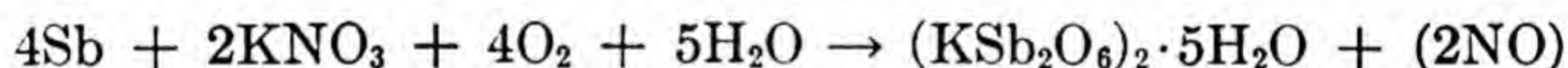
J. Preuss, Ann., **31**, 198 (1839)

25

Sb

KNO₃ + O₂**I-776**

Granular crystals are formed when metallic antimony is burned with saltpeter and the resultant product extracted with water.



Rammelsberg, Pogg. Ann., **52**, 193

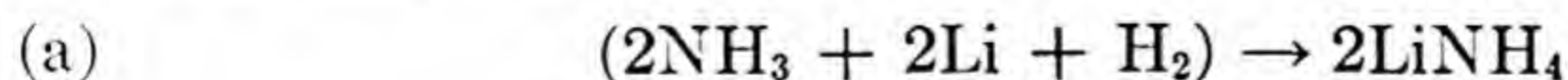
Ref., F. Warrentrop and H. Will, Ann., **40**, 278

1

Sb

Li**I-777**

When a small fragment of antimony is heated with lithium in a sealed tube containing liquid ammonia, blue lithium ammonium is formed. The blue color disappears, leaving lithium antimonide.



P. Lebeau, Compt. rend., **134**, 284-286 (1902)

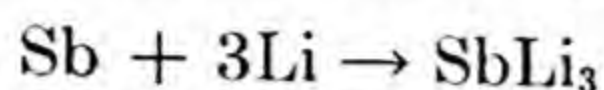
2

Sb

Li

I-778

Lithium antimonide is formed when a small fragment of antimony is heated with lithium in a sealed tube containing liquid ammonia.



Lebeau, *Compt. rend.*, **134**, 284 (1902)

Ref., *J. Chem. Soc. (London)*, **82**, 256 (1902)

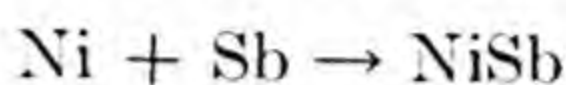
1

Sb

Ni

I-779

Nickel antimonide is formed when antimony vapors are carried by a current of hydrogen to an adjacent capsule of nickel in a porcelain tube heated to 1300°, then quickly cooled in a current of hydrogen.



E. Vigouroux, *Compt. rend.*, **147**, 978 (1908)

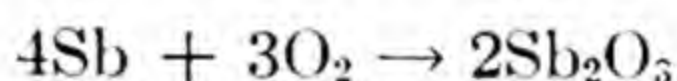
38

Sb

O₂

I-780

Antimony burned in either dry or wet oxygen forms antimony trioxide.



H. Brereton Baker, *Trans. Roy. Soc. (London)*, **179A**, 571 (1889)

105

Sb

O₂

I-781

An important secondary equilibrium is set up at an antimony interface, of the antimony electrode, when it is submerged in an aqueous solution in contact with air.



George A. Perley, *Chem. Met. Eng.*, **40**, 417 (1933)

44

Sb

PCl₅

I-782

Finely powdered antimony combines instantly with phosphorus pentachloride; the reaction is exothermic.



E. Baudrimont, *Ann. d. Chim. Phys.*, (4), **2**, 12 (1864)

70

Sb

S

I-783

The elements antimony and sulfur mixed in correct proportions and heated in a sealed tube, combine at 450° to give the sulfide. When different proportions of the reagents are used the mixture solidifies in two phases.



H. Pélabon, *J. Chim. phys.*, **2**, 321 (1904)

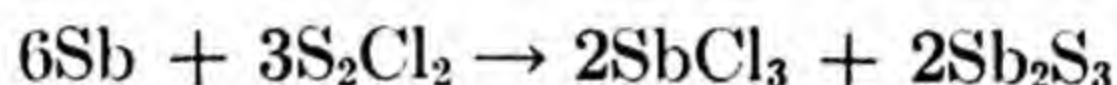
69

Sb

S₂Cl₂

I-784

Antimony trichloride is obtained when powdered antimony is heated with sulfur monochloride.



F. Wöhler, *Ann.*, **73**, 375 (1850)

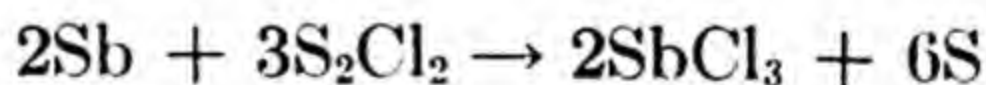
25

Sb

S₂Cl₂

I-785

Antimony reacts readily with sulfur monochloride in the cold producing antimony trichloride.



P. Nicolardot, *Compt. rend.*, **147**, 1305 (1908)

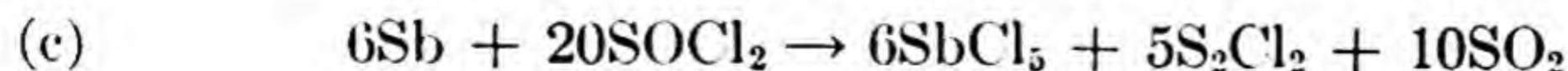
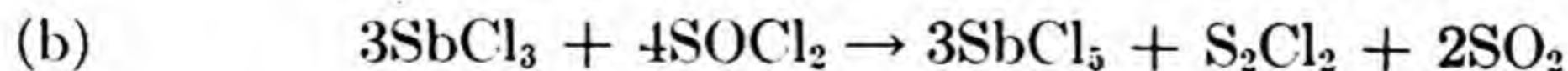
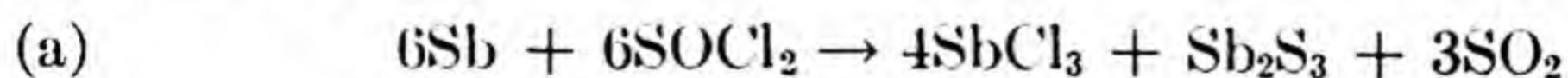
38

Sb

SOCl₂

I-786

Antimony trichloride is produced when an excess of antimony reacts with thionyl chloride, (a). When an excess of thionyl chloride is used and the mixture heated in a sealed tube, antimony pentachloride is produced, (b), (c).



Teumann and Köchlin, *Ber.*, **16**, 1625 (1883)

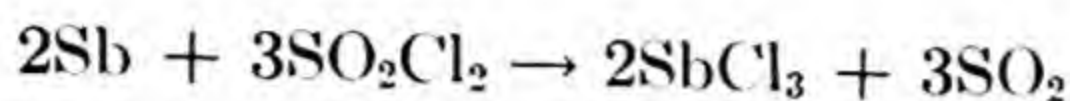
Ref., North and Hageman, *J. Am. Chem. Soc.*, **34**, 893 (1912)

1

Sb

SO₂Cl₂**I-787**

Antimony trichloride is formed when antimony is heated in a mixed atmosphere of sulfuryl chloride and carbon dioxide at a temperature of 170°.



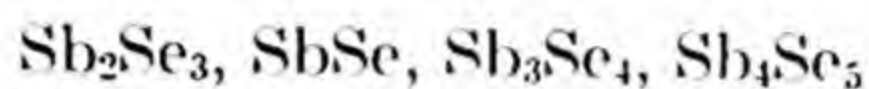
H. Danneel and F. Schlottmann, *Z. anorg. Chem.*, **212**, 225 (1933)

28

Sb

Se**I-788**

It has been shown that antimony forms the following compounds with selenium:



P. Chretien, *Compt. rend.*, **142**, 1339

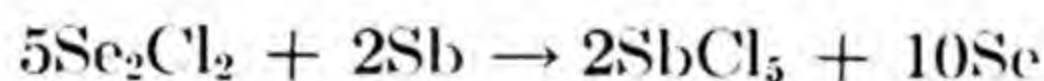
Ref., H. Pélabon, *Compt. rend.*, **146**, 976 (1908)

38

Sb

Se₂Cl₂**I-789**

Antimony pentachloride is formed as an intermediate product when selenium monochloride reacts with antimony.



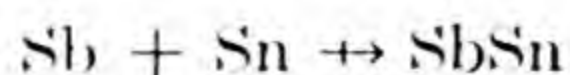
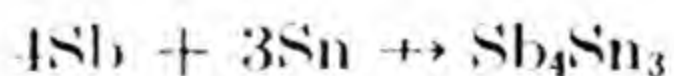
Lenher and Kao, *J. Am. Chem. Soc.*, **48**, 1553 (1926)

1

Sb

Sn**I-790**

Freezing points and microscopic examination of antimony-tin alloys indicate that solid solutions and not compounds are formed on cooling the liquid melts. This contradicts and corrects claims that compounds are formed. Such claims have been made by Reinders, *Zeit. anorg. Chem.* **25**, 113 (1900).



F. E. Gallagher, *J. Phys. Chem.*, **10**, 93 (1906)

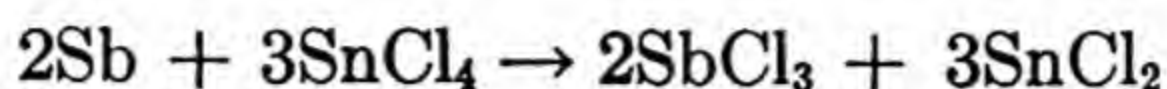
7

Sb

~~Sb~~Cl₄

I-791

Antimony reduces stannic to stannous salts, but does not reduce stannous salts to tin.



H. C. Boehmer, J. R. Gordon and C. W. Simmons, *Can. Chem. J.*, **4**, 172 (1920)

15

Ref., H. F. Hourigan, *Analyst*, **61**, 328 (1936)

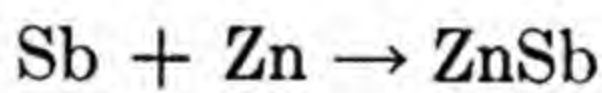
40

Sb

Zn

I-792

The equilibrium diagram shows that the compound, ZnSb, is deposited when melts of antimony and zinc containing less than 40% zinc are solidified. Two solid solutions as well as the two pure metals are also represented in the phase diagram. There is no evidence for Zn₃Sb₂ or ZnSb₂ claimed by others.



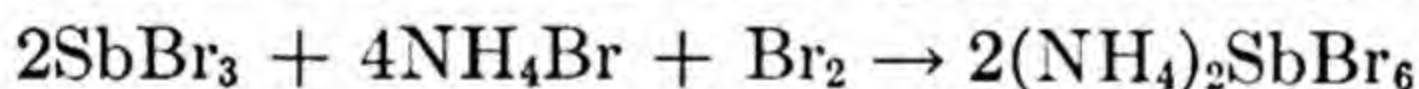
B. E. Curry, *J. Phys. Chem.*, **13**, 589 (1909)

7

SbBr₃Br₂ + NH₄Br

I-793

Black octahedral crystals, stable in air, form when the required quantity of bromine, followed by ammonium bromide is added to a solution of antimony tribromide in concentrated hydrobromic acid.



Ephraim and Weinberg, *Ber.*, **42**, 4447 (1909)

Ref., C. H. Desch, *J. Chem. Soc.*, **98**, 41 (1910)

25

SbBr₃

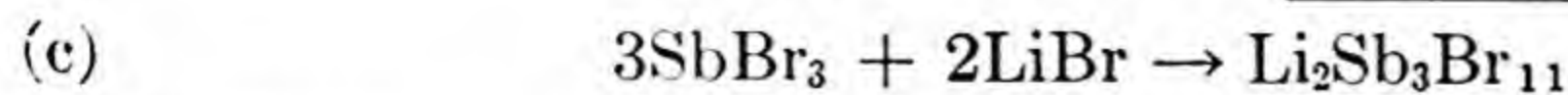
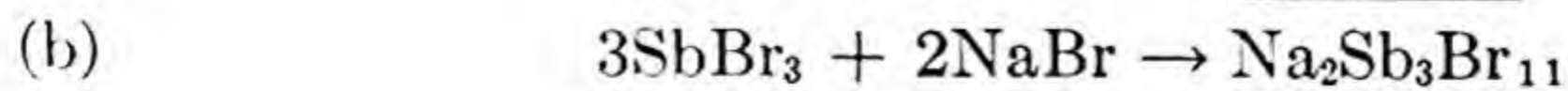
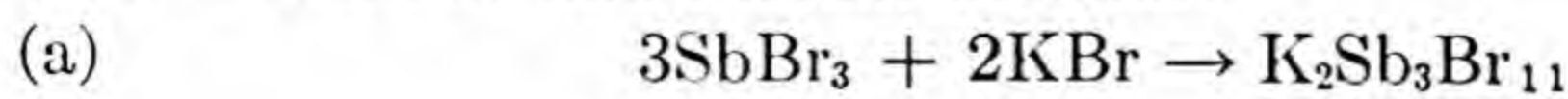
KBr

I-794

NaBr

LiBr

2.169 grams of antimony tribromide are mixed with 0.476 gram of potassium bromide. 10 cc of acetone are added. Heat on the steam bath. By leaving it over concentrated sulfuric acid in vacuo yellow colored crystals are formed. The same type reaction occurs with sodium bromide and lithium bromide.



Ch Vournazos, *Z. anorg. Chem.*, **192**, 369 (1930)

28

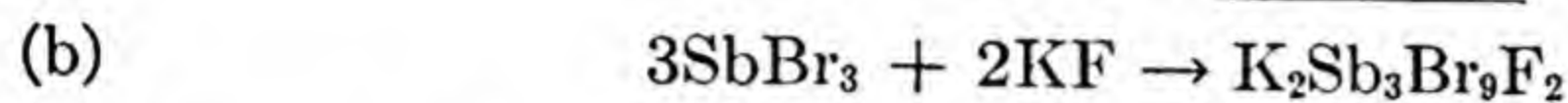
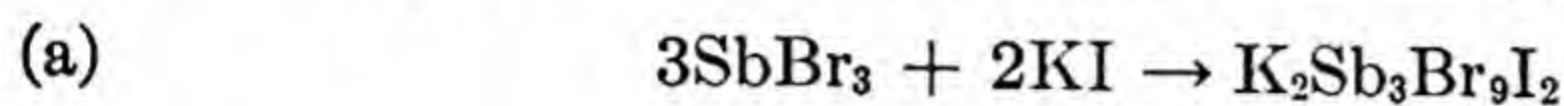


KI

I-795

KF

1.084 grams of antimony tribromide and 0.332 gram of potassium iodide in 5 cc of acetone are heated on the steam bath. By slow evaporation yellow crystals of potassium-antimony-bromo iodide are formed. The same type reaction occurs with potassium fluoride.



Ch. Vournazos, *Z. anorg. Chem.*, **192**, 369 (1930)

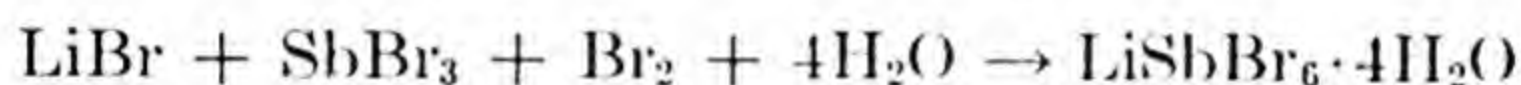
28



LiBr

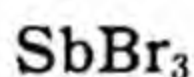
I-796

Dissolve equal molecular portions of lithium bromide and antimony tribromide in water with the addition of much bromine and concentrated hydrobromic acid. Black, right-angled, four-sided tablets of lithium metabromo antimonate are formed.



Weinland and Flige, *Ber.*, **36**, 244-59 (1903)

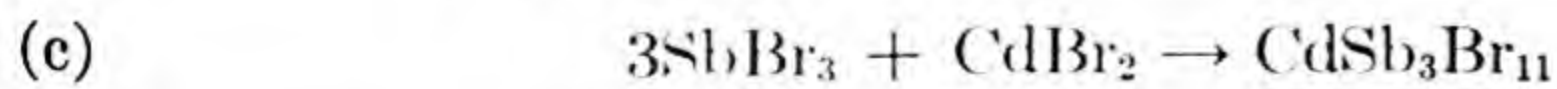
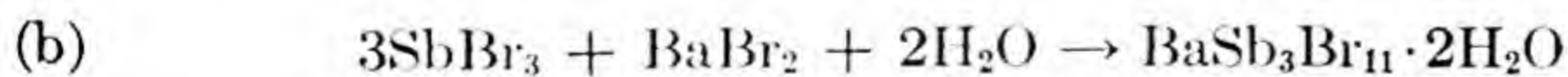
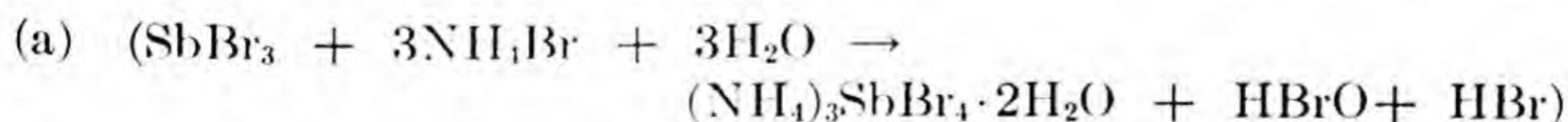
2

NH₄Br

I-797

BaBr₂CdBr₂

To 1.446 grams of antimony tribromide and 0.7836 grams of ammonium bromide add 10 cc of acetone plus a few drops of water. Shake. By leaving in a vacuum desiccator over concentrated sulfuric acid yellow crystals are obtained. The same type reaction occurs with barium bromide and cadmium bromide.



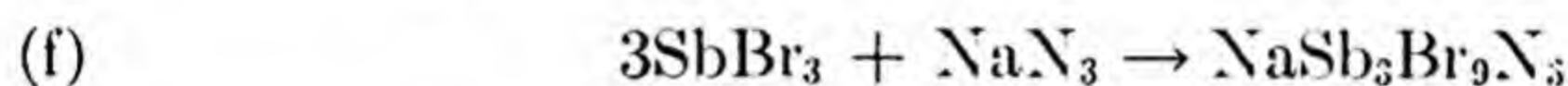
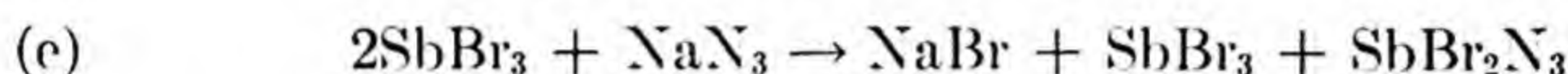
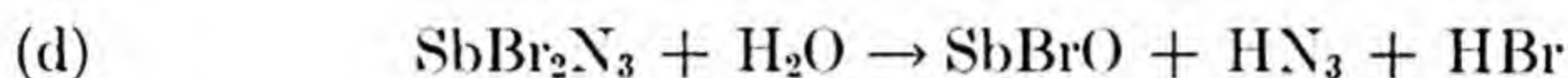
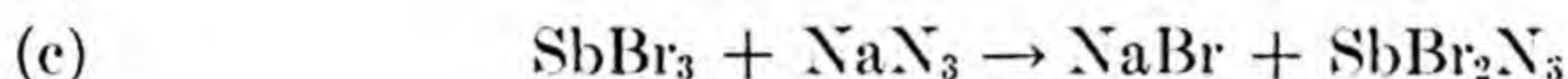
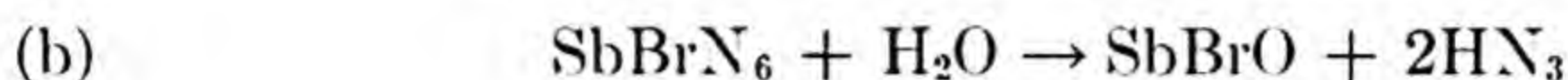
Ch. Vournazos, *Z. anorg. Chem.*, **192**, 369 (1930)

28

SbBr₃NaN₃

I-798

By leaving a mixture of antimony tribromide (3.2536 g) and sodium triazide (0.195 g) in 20 cc of acetone to which a small amount of water is added, in a vacuum desiccator a white crystalline substance, sodium-antimony-bromotriazide is obtained.



Ch. Vournazos, *Z. anorg. Chem.*, **192**, 369 (1930)

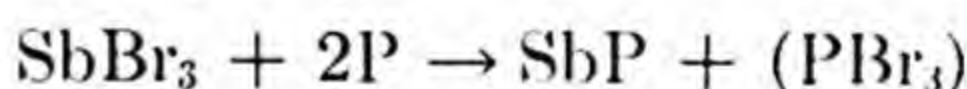
28

SbBr₃

P

I-799

Antimony tribromide reacts with phosphorus dissolved in carbon disulfide to form antimony phosphide.



W. Ramsey, *Ber.*, **6**, 1362 (1873)

11

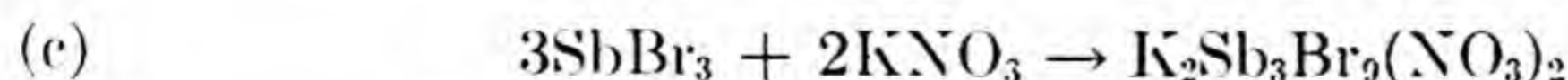
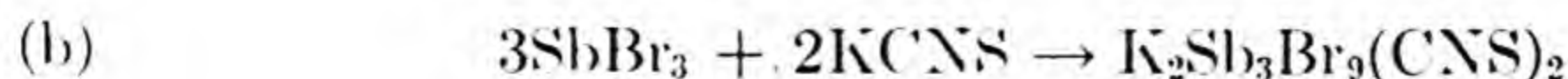
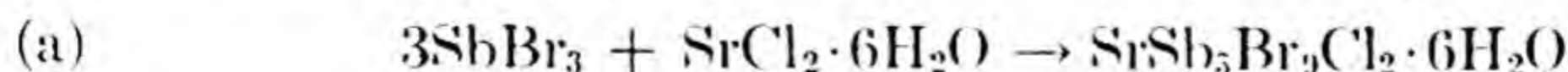
SbBr₃SrCl₂·6H₂O

I-800

KCNS

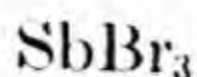
KNO₃

By leaving antimony tribromide (1.446 g) and strontium chloride hexahydrate (0.3555 g) in 10 cc of acetone in a vacuum desiccator colorless needles of strontium-antimony-bromochloride are obtained. The same type reaction occurs with potassium thiocyanate and potassium nitrate.



Ch. Vournazos, *Z. anorg. Chem.*, **192**, 369 (1930)

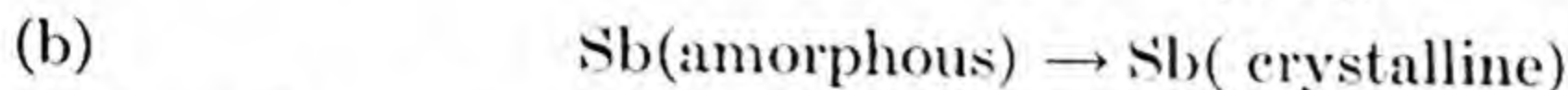
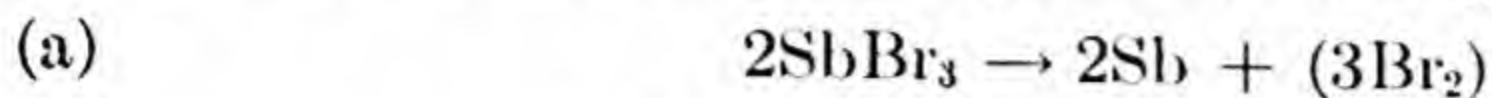
28



€

I-801

Antimony tribromide was electrolyzed in presence of excess hydrobromic acid, using an antimony anode. Antimony was deposited in an active form which tended to explode on heating to 270°–300°F.



G. Gore, Trans. Roy. Soc. (London), **152**, 323 (1863)

105

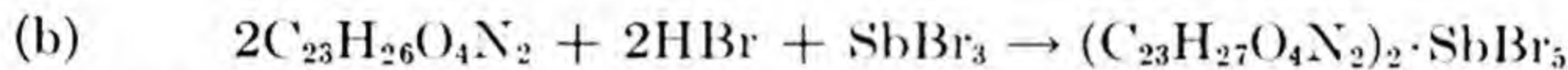
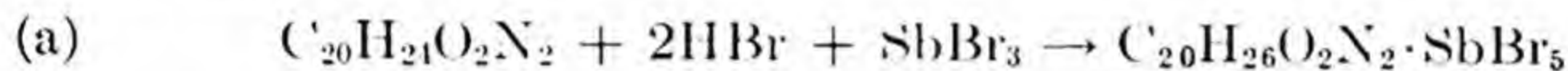


Quinine

I-802

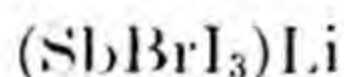
HBr

Addition of a dilute acid solution of antimony tribromide to a dilute acid solution of quinine containing an excess of potassium bromide yielded a precipitate of the quinine complex which evolves a gas at 50–60°C., (a). Brucine similarly yields a complex, (b), which gives off a gas at 186–197°C.



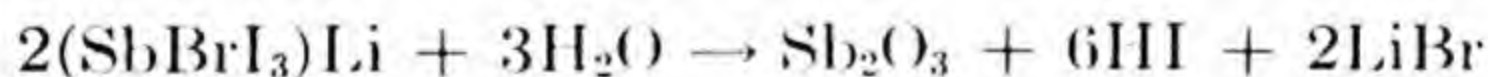
E. P. White, J. Am. Pharm. A., **30**, 156 (1941)

112

H₂O

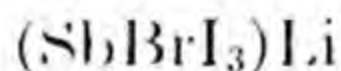
I-803

Lithium antimony triiodobromide is decomposed by water giving antimony trioxide, hydriodic acid, and lithium bromide.



A. Ch. Vournazos, Compt. rend., **175**, 164–7 (1922)

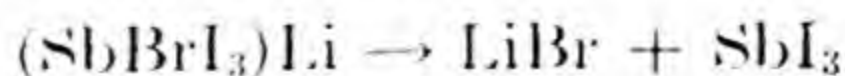
2



Δ

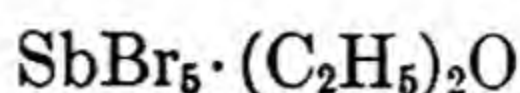
I-804

Lithium antimony triiodobromide is decomposed at red heat into lithium bromide and antimony triiodide.



A. Ch. Vournazos, Compt. rend., **175**, 164–7 (1922)

2



Δ

I-805

Antimony pentabromide diethyl oxide is a stable compound at ordinary temperatures but when heated to 87–88°C it decomposes according to the following equation:



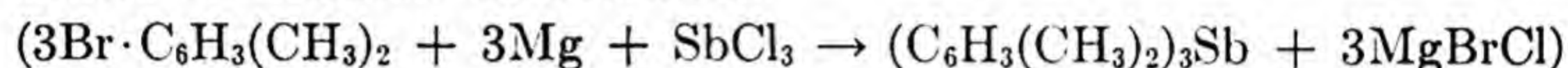
M. A. Raynaud, *Bull. Soc. Chim. (IV)*, **27**, 327 (1920)

31



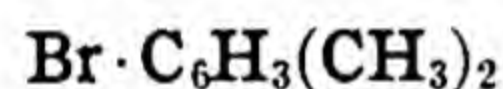
I-806

To an ethereal solution containing 4-bromo-m-xylene and magnesium (Grignard's reagent), antimony trichloride is added and the mixture boiled for six hours. After decomposition with water, tri-m-xylyl-stibine is extracted with benzene.



Archibald E. Goddard, *J. Chem. Soc.*, **123:2**, 2319 (1923)

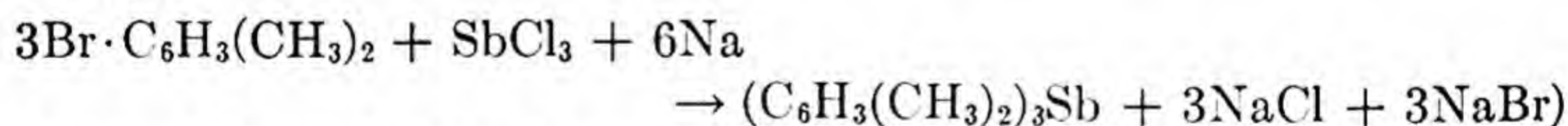
48



I-807

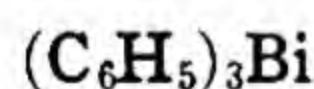
Na

4-bromo-m-xylene and antimony trichloride are dissolved in dry benzene and sodium is added in thin slices. After standing overnight, the solution is filtered and the residue extracted with boiling benzene. The latter is then evaporated and the oily residue, after treatment with absolute alcohol, yields tri-m-xylyl-stibine in form of long, crystalline needles.



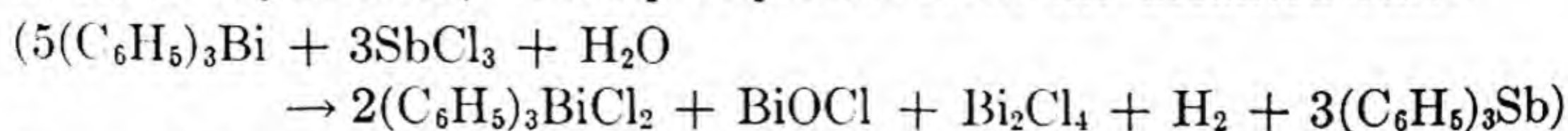
Archibald E. Goddard, *J. Chem. Soc.*, **123:2**, 2319 (1923)

48



I-808

If antimony trichloride (1 mole) in dry ether is added to triphenylbismuth (1 mole) in the same solvent, a white precipitate consisting largely of inorganic compounds of arsenic and bismuth is obtained. From the decanted ether, triphenylantimony dichloride and diphenylbismuth chloride are isolated. No inorganic products are determined, except bismuth oxychloride, which precipitates from the decanted ether.



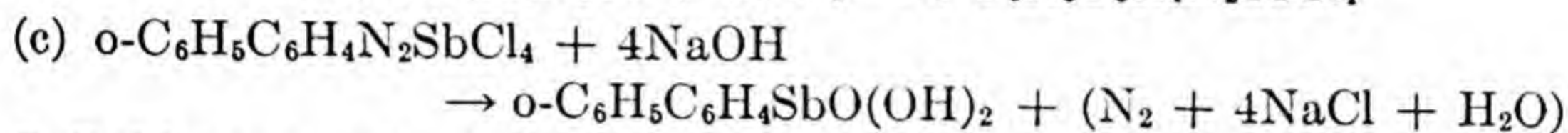
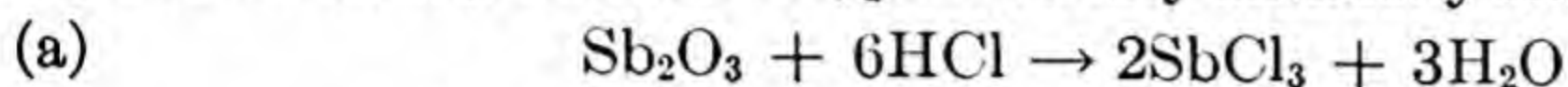
Frederick Challenger and Leslie R. Ridgway, *J. Chem. Soc.*, **121:1**, 115 (1922)

48

SbCl_3 $\text{o-C}_6\text{H}_5\text{C}_6\text{H}_4\text{N}_2\text{Cl}$

I-809

o-Xenylamine (50 g.) is diazotized to *o*-xenyldiazonium chloride. To this is added 46 g. of antimony trioxide in 200 ml. of hydrochloric acid (d. 1.126) at 0–25°. *o*-Xenyldiazonium antimony tetrachloride separates as light yellow crystals. These are suspended in water and 200 ml. of glycerine and 330 ml. of 5 *N* sodium hydroxide are added. The filtered solution is acidified with hydrochloric acid, the precipitated *o*-xenylstibonic acid is washed with hydrochloric acid (d. 1.126) and recrystallized from alcohol. This compound may be used to prepare other organic antimony derivatives, particularly antimony analogs of carbazole.

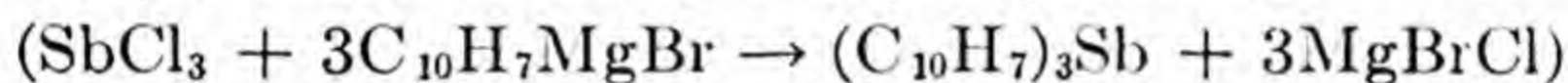


G. T. Morgan and G. R. Davies, *Proc. Roy. Soc. (London)*, **127A**, 1 (1930) 110

 SbCl_3 $\text{C}_{10}\text{H}_7\text{MgBr}$

I-810

Antimony trichloride (1 mole) in benzene is slowly added to an ethereal solution of magnesium- α -naphthyl-bromide (3 moles); the solvents are then removed and the residue, after washing, filtering and extracting with benzene, is found to be tri- α -naphthyl-stibine.

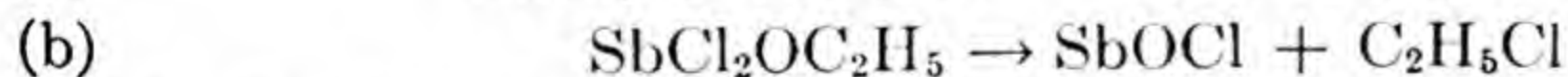
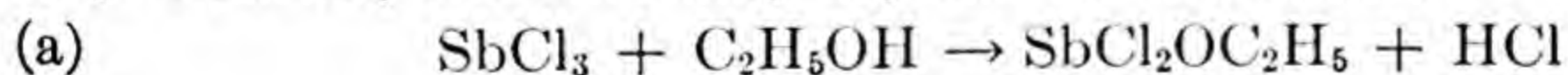


Frederick Challenger and Freda Pritchard, *J. Chem. Soc.*, **125**: 1, 868 (1924) 48

 SbCl_3 $\text{C}_2\text{H}_5\text{OH}$

I-811

When one mole of antimony trichloride and one mole of absolute ethanol are heated several hours in a sealed tube at 160°C., hydrogen chloride, ethyl chloride, and antimony oxychloride are formed.

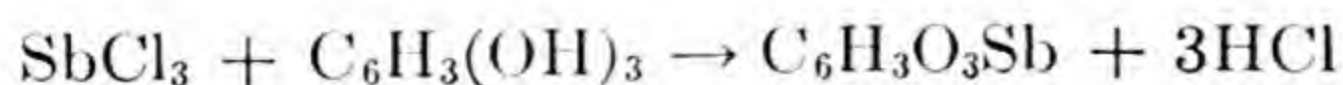


L. Schaeffer, *Ber.*, **1**, 136 (1868) 11

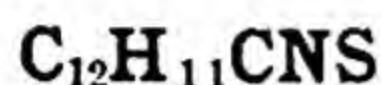
 SbCl_3 $\text{C}_6\text{H}_3(\text{OH})_3$

I-812

Antimony trichloride reacts with pyrogallol, yielding characteristic crystals.

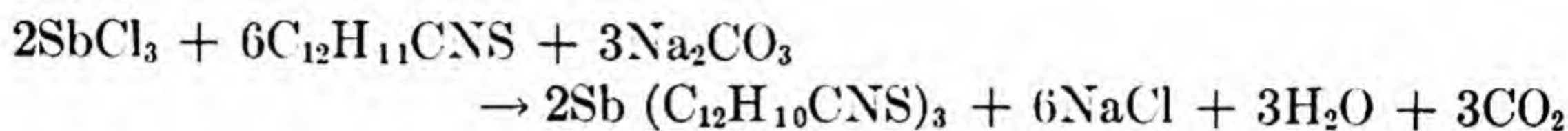


F. Feigl, *Mikrochem.*, **1**, 75 (1923) 28



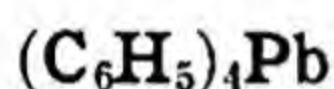
I-813

Antimony trichloride will react with a 2% alcoholic solution of thio-glycolic acid β -amino naphthalide (Thionalide), yielding a crystalline precipitate of yellow color.



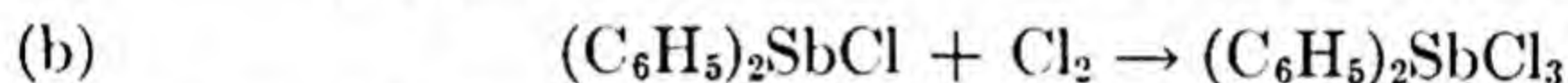
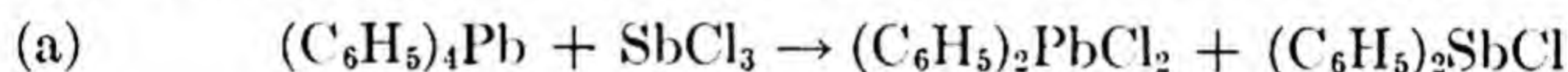
R. Berg and E. S. Fahrenkamp, *Z. anal. Chem.*, **112**, 161 (1938)

28



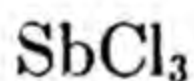
I-814

Lead tetraphenyl and antimony trichloride are heated under reflux with toluene for half an hour; the resulting solid mass, after treatment with toluene, heating and filtering, is found to contain lead diphenyl-chloride (residue) and oily diphenyl-stibine-chloride (filtrate), (a). The latter, upon chlorination, yields diphenyl-stibine-trichloride, (b).



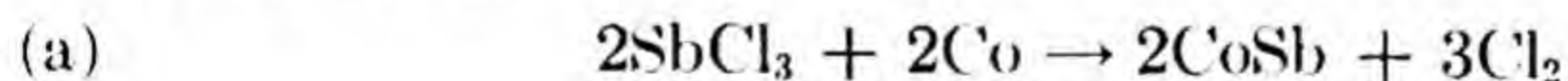
A. E. Goddard, J. N. Ashley and R. B. Evans, *J. Chem. Soc.* **121**, 980 (1922)

48



I-815

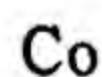
The compound cobalt antimonide is first formed when antimony trichloride reacts with finely powdered cobalt at 800°. This compound breaks up at higher temperatures into cobaltous chloride and antimony.



Ducelliez, *Compt. rend.*, **147**, 1048

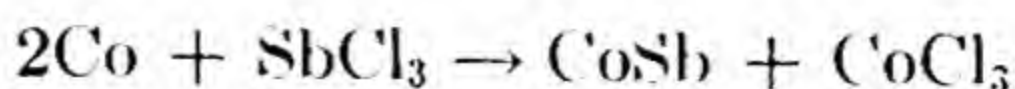
Ref., J. L. Howe, *J. Am. Chem. Soc.*, **31**, 1297 (1909)

1



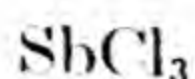
I-816

When finely divided cobalt is subjected to the action of vapors of antimony trichloride at temperatures around 800°, cobalt antimonide is formed.

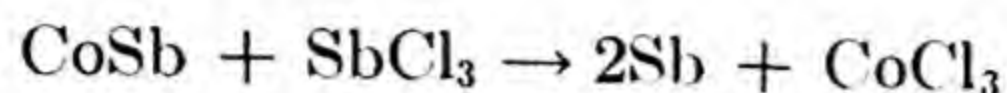


F. Ducelliez, *Compt. rend.*, **147**, 1048 (1908)

38


CoSb
I-817

Cobalt antimonide is attacked by vapors of antimony trichloride, particularly at temperatures above 1000° , with deposition of antimony and formation of cobaltic chloride.

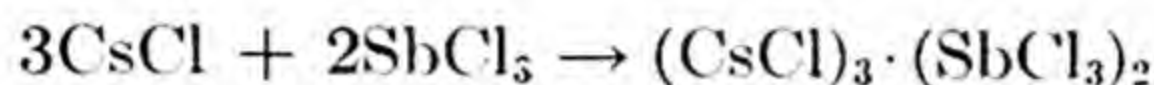


F. Ducelliez, *Compt. rend.*, **147**, 1048 (1908)

38


CsCl
I-818

Mixing solutions of caesium chloride and antimony trichloride in varying proportions yields the 3:2 double chloride of caesium and antimony though the crystals vary from white hexagonal tablets to large irregular yellow scales.

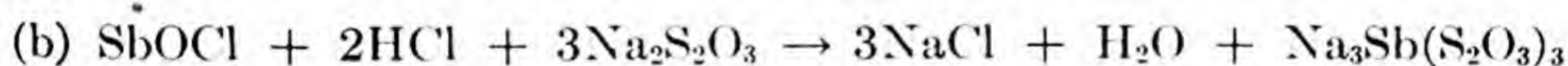
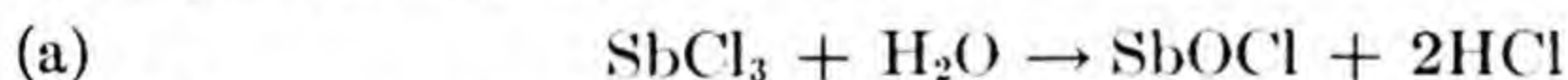


C. Setterberg, *K. Sv. Vet. Akad. Handl. Öfvers.*, **39**, No. 6, 26 (1882)

10


HCl + Na₂S₂O₃
I-819

Trisodium antimony thiosulfate is formed when the hydrolysis product of antimony trichloride is dissolved in concentrated sodium thiosulfate in the presence of hydrochloric acid.



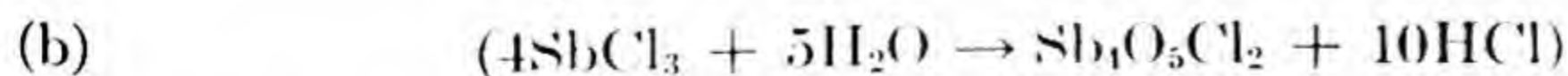
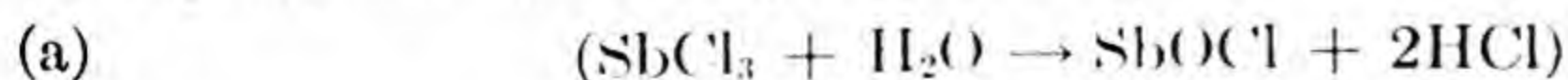
Julius von Szilágyi, *Z. anorg. Chem.*, **113**, 69 (1920)

25


H₂O
I-820

If water be added to a solution of antimony trichloride, various oxychlorides can be obtained depending on the amount of water added and on the amount of free acid in solution.

When 1 mole of antimony trichloride is treated with 8 moles of water, antimonyl chloride is formed, (a). When 27 mole of water are used, the oxychloride shown in (b) is formed.



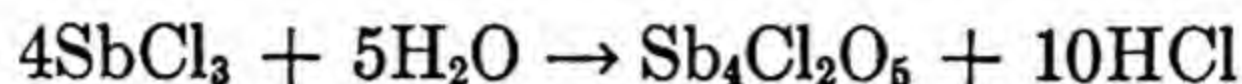
C. Lea and J. K. Wood, *J. Chem. Soc.*, **125**, 138 & 141 (1924)

48



I-821

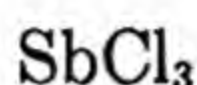
Cold water (4-75 parts to 1 part antimony trichloride) hydrolyzes antimony trichloride to form a complex salt and hydrochloric acid.



Sabanejeff,

Ref., V. Von Richter, Ber., 4, 409 (1871)

11



I-822

Boiling water (small excess) hydrolyzes with antimony trichloride to form a complex salt and hydrogen chloride.



Sabanejeff,

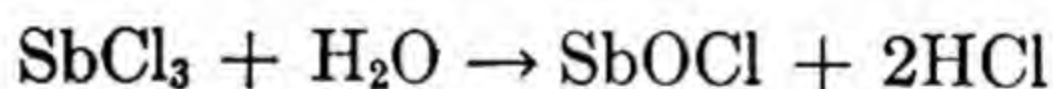
Ref., Von Richter, Ber., 4, 409 (1871)

11



I-823

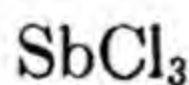
Cold water (2-45 moles) decomposes antimony trichloride to form antimony oxychloride and hydrochloric acid.



Sabanejeff,

Ref., Von Richter, Ber., 4, 409 (1871)

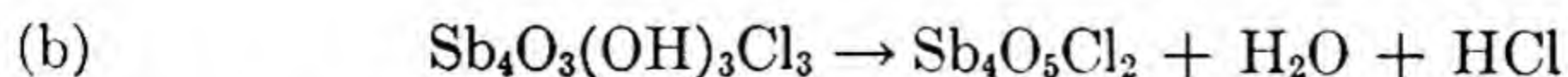
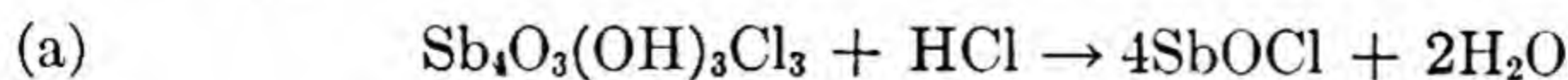
11



I-824

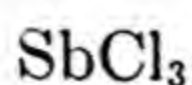
Various metastable oxychlorides of antimony are formed when water is added to solid antimony trichloride.

The oxychlorides subsequently change into stable forms either by absorbing hydrochloric acid (a), or by setting it free (b).

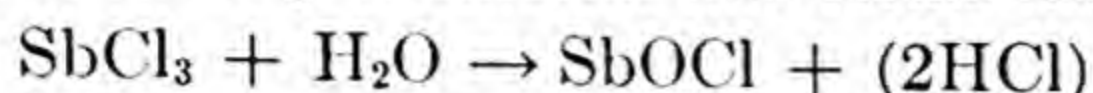


Charles Lea and John K. Wood, J. Chem. Soc. (London), 125, 147 (1924)

48

**H₂O****I-825**

Water hydrolyzes antimony trichloride and forms the oxychloride.

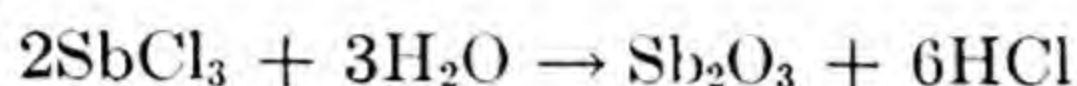


John Davy, Trans. Roy. Soc. (London), **102**, 190 (1812)

105

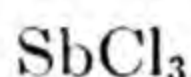
**H₂O****I-826**

Antimony trichloride reacts with water to give antimony trioxide and hydrochloric acid.

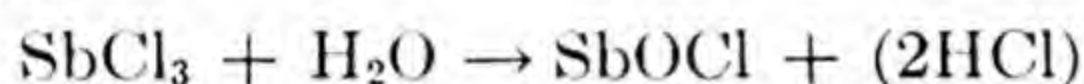


Humphry Davy, Trans. Roy. Soc. (London), **101**, 23 (1811)

105

**H₂O****I-827**

Water added to a solution of antimony trichloride precipitated the antimonyl chloride.

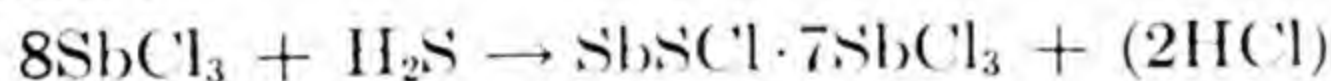


George Pearson, Trans. Roy. Soc. (London), **81**, 323 (1891)

105

**H₂S****I-828**

Lemon yellow crystals are obtained when antimony trichloride reacts with liquid hydrogen sulfide at ordinary temperatures and the solution evaporated to crystallization. This same compound can be formed by the action of dry hydrogen sulfide gas on dry antimony trichloride at low temperatures.



Schneider, Pogg. Ann. phys. Chem., **108**, 407 (1859)

Ref., Ralston and Wilkinson, J. Am. Chem. Soc., **50**, 262 (1928)

1

**H₂Se****I-829**

Dark brown precipitate of antimonious selenide was obtained when antimonious chloride was dropped into a pure saturated solution of hydrogen selenide.



Moser and Atynski., Monatsh., **45**, 235 (1925)

Ref., A. C., J. Chem. Soc. (London), **128**, 584 (1925)

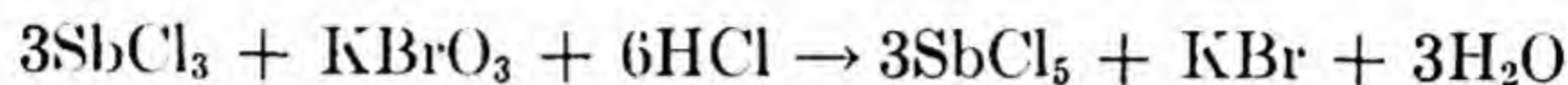
25



I-830



A new short method for the accurate determination of antimony in metals, alloys and ores is based on the titration of antimonious chloride with potassium bromate in the presence of hydrochloric acid.

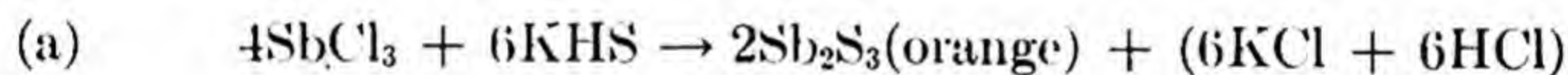


Silve Kallmann and Frank Pristera, *Ind. Eng. Chem., Anal. Ed.*, **13**, 8 (1941) 44

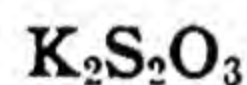


I-831

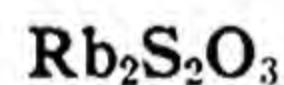
Potassium hydrosulfide reacts with antimony trichloride to form golden sulfur of antimony. When heated it gives black antimony trisulfide and water.



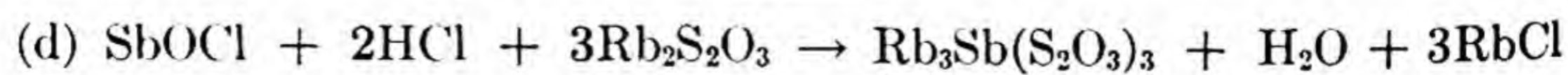
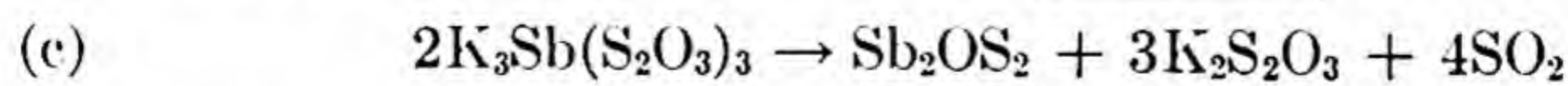
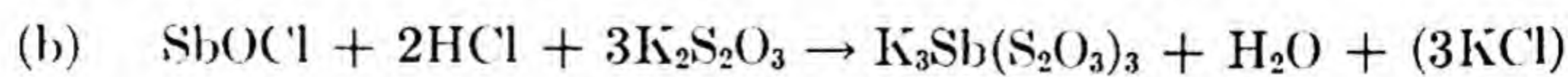
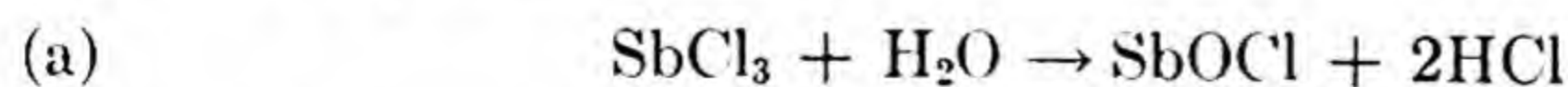
John Davy, *Trans. Roy. Soc. (London)*, **102**, 189 (1812) 105



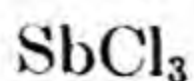
I-832



A solution of antimony trichloride will react with a concentrated solution of potassium thiosulfate yielding crystals of potassium-antimony thiosulfate. These crystals are decomposed when heated with water. The same type reaction occurs with rubidium thiosulfate.



J. v. Szilágyi, *Z. anorg. Chem.*, **113**, 69 (1920) 28

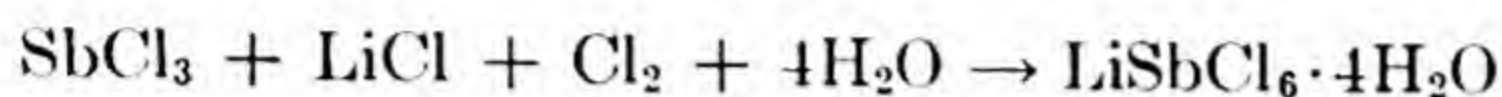


LiCl

I-833

Cl₂

Saturate a solution of lithium chloride and antimony trichloride with chlorine. Right-angled, four-sided, hygroscopic sheets of lithium metachloroantimonate are formed.



Weinland and Feige, Ber., **36**, 244 (1903)

2

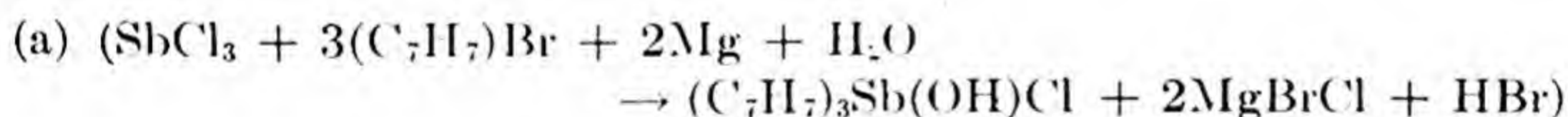


Mg

I-834

C₇H₇Br

Antimony trichloride in benzene is treated with a Grignard reagent made up of m-bromotoluene and magnesium. The mixture is then treated with steam and oily, non-volatile tri-m-tolyl-antimony-hydroxy chloride is obtained, (a). With hot alcoholic hydrogen chloride, this compound yields tri-m-tolyl-antimony dichloride, (b). No tri-m-tolyl stibine is isolated.



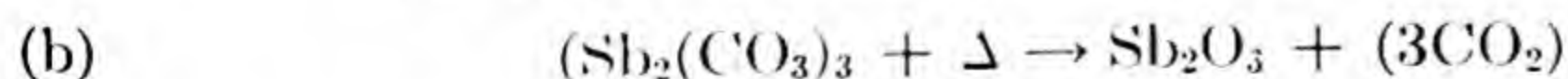
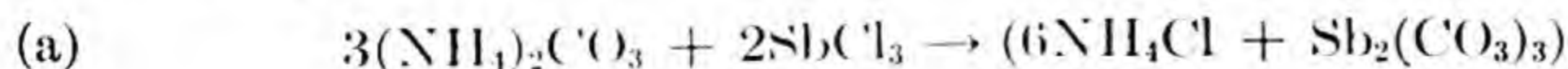
Frederick Challenger and Freda Pritchard, J. Chem. Soc., **125**: **1**, 869 (1924)

48

(NH₄)₂CO₃

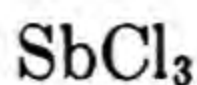
I-835

Antimony trioxide is the product resulting when antimony trichloride is precipitated with ammonium carbonate and the precipitate washed, dried and ignited.



J. B. Moyer, J. Am. Chem. Soc., **18**, 1032 (1896)

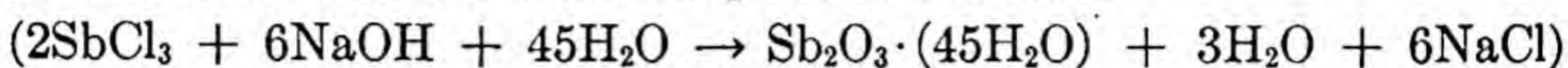
1



NaOH

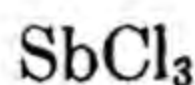
I-836

When a slight excess of sodium hydroxide is added to a solution of antimony trichloride, a precipitate of the hydrated oxide shown below is formed. No antimonyl chloride is formed. Similar results are obtained when a solution of antimony trichloride in hydrochloric acid is poured into a solution containing excess ammonia.



Charles Lea and John K. Wood, *J. Chem. Soc.*, **123**: 1, 263 (1923)

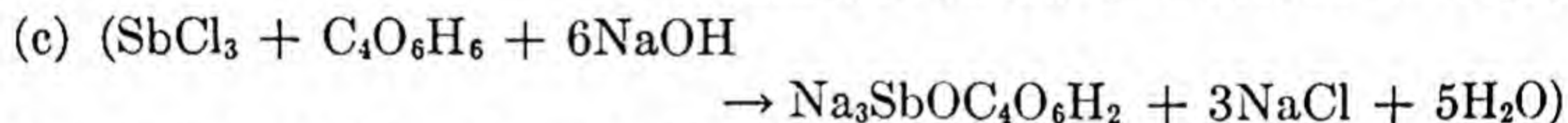
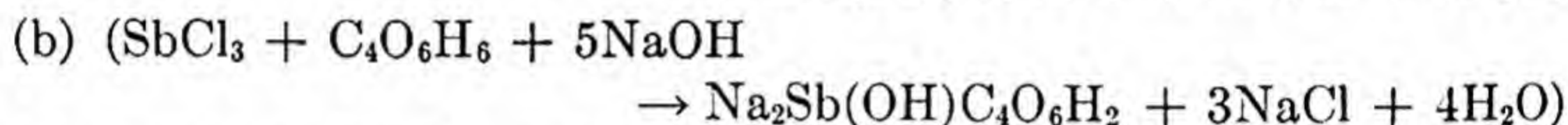
48



NaOH + C₄O₆H₆

I-837

The neutralization curve of a solution of antimony trichloride and tartaric acid shows three maxima corresponding to the following complexes:



J. L. Delsal, *J. Chim. phys.*, **35**, 350 (1938)

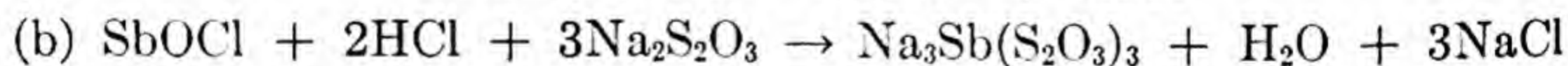
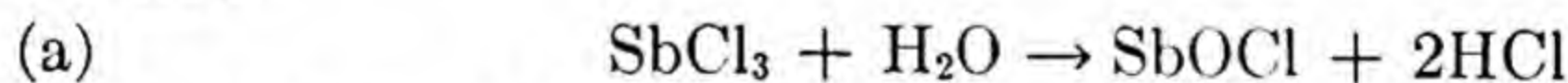
69



Na₂S₂O₃

I-838

A solution of antimony trichloride will react with a more concentrated solution of sodium thiosulfate yielding sodium-antimony thiosulfate in solution.



J. v. Szilágyi, *Z. anorg. Chem.*, **113**, 69 (1920)

28

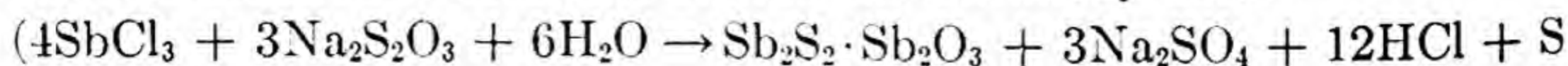


Na₂S₂O₃

I-839

H₂O

When antimony trichloride and sodium thiosulfate solution are mixed and heated a red precipitate is formed. This is called antimony cinnabar and consists of antimony sulfide and antimony oxide.



L. Svanberg, -K. Sv. Vet. Akad. Handl. Öfversigt., **18**, 235 (1861)

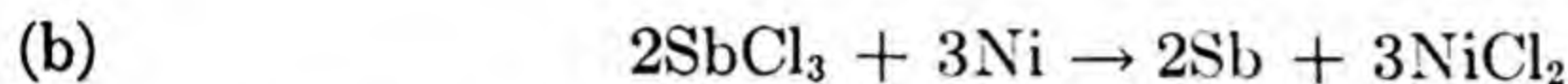
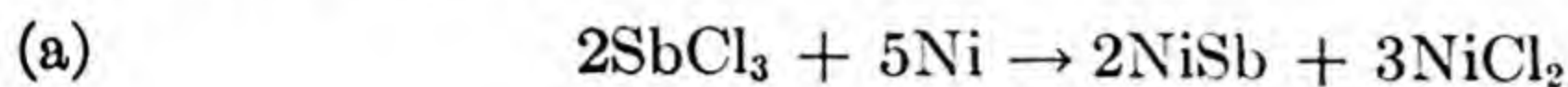
10



Ni

I-840

Antimony trichloride is passed for three hours over powdered nickel in a porcelain tube heated to 800° . The product is washed with water to remove the nickel chloride formed. Nickel antimonide remains, (a). Temperatures above 800° cause formation of metallic antimony and nickel chloride, (b).



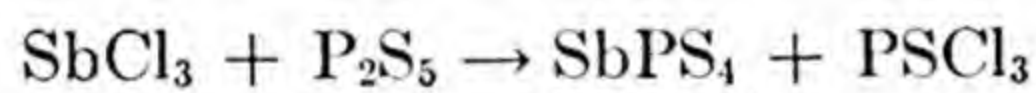
E. Vigouroux, *Compt. rend.*, **147**, 976-7 (1908)

38

 P_2S_5

I-841

Antimony thiophosphate of yellow color is obtained when a mixture of antimonous chloride and phosphorus pentasulfide is heated.



E. Glatzel, *Z. anorg. Chem.*, **4**, 186 (1893)

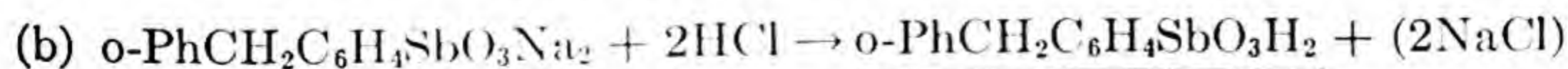
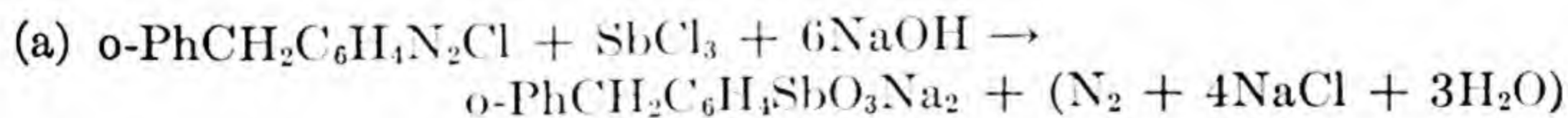
28

o-PhCH₂C₆H₄N₂Cl

I-842

NaOH

o-Benzylbenzenediazonium chloride (diazotized o-aminodiphenylmethane) (22 g.) is treated with 14.5 g. of antimony oxide in 45 ml. of hydrochloric acid (d. 1.16) and 60 ml. of glycerine. After adding 150 ml. of 5 N sodium hydroxide to the cold mixture, the mixture is warmed for 15 minutes, filtered, neutralized, saturated with carbon dioxide, and filtered again. o-Diphenylmethane-2-stibonic acid is precipitated from this solution with hydrochloric acid. This compound may be converted into other organic antimony compounds, particularly antimony analogs of acridine.

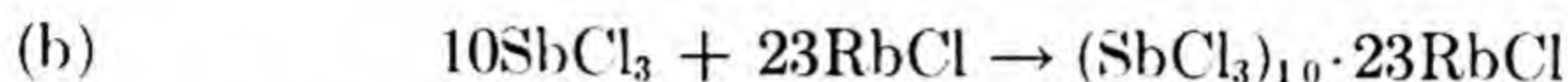
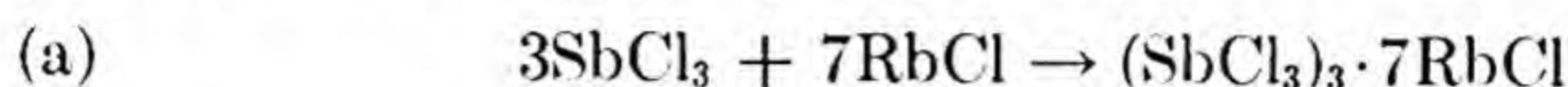


G. T. Morgan and G. R. Davies, *Proc. Roy. Soc. (London)*, **143A**, 38 (1933)

110

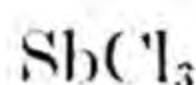
**RbCl****I-843**

Crystals of two different kinds of double salts of antimony and rubidium chloride separate from hydrochloric acid solutions when these salts are present in stoichiometric proportions.

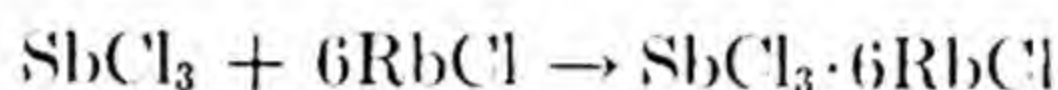


I. Remsen and A. P. Saunders, *Am. Chem. J.*, **14**, 152 (1892)

44

**RbCl****I-844**

When a mixed solution of antimony chloride and rubidium chloride in concentrated HCl is evaporated, beautiful crystals of antimony rubidium chloride remain.

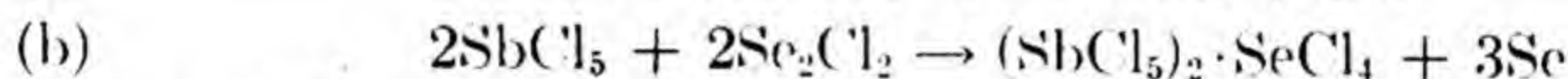
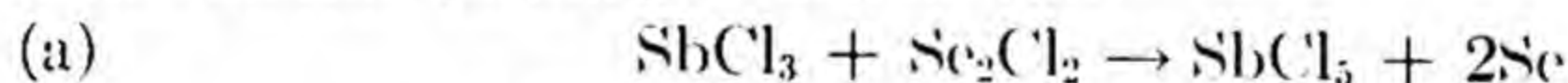


R. Godeffroy, *Ber.*, **8**, (1), 10 (1875)

28

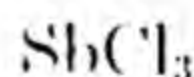
**Se₂Cl₂****I-845**

Antimony trichloride is oxidized when warmed with selenium monochloride and the resulting pentachloride reacts with an excess of selenium monochloride yielding a double salt.

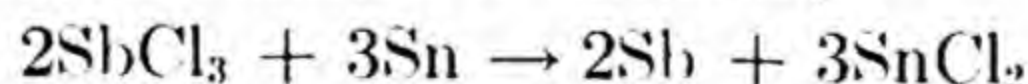


Lenher and Kao, *J. Am. Chem. Soc.*, **48**, 1554 (1926)

1

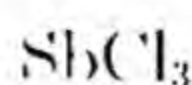
**Sn****I-846**

Tin reduces antimony trichloride to antimony.

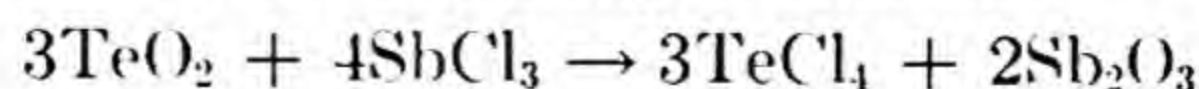


H. C. Boehmer, J. R. Gordon and C. W. Simmons, *Can. Chem. J.*, **4**, 172 (1920)

15

**TeO₂****I-847**

Tellurium tetrachloride and antimony trioxide are formed when tellurium dioxide reacts with antimony trichloride.



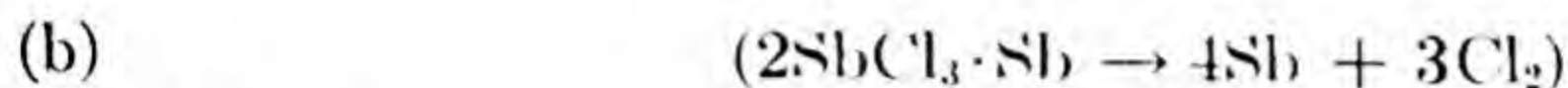
V. Lenher, *J. Am. Chem. Soc.*, **30**, 740 (1908)

1

SbCl_3

I-848

Explosive antimony is deposited electrolytically from 10% hydrochloric acid solutions of antimony trichloride. Electrolysis is carried out at 0° with solutions containing 15% or less of antimony trichloride or at 19–21° for 15–75% solutions. One phase of the gel-like structure of the explosive antimony is regarded as a complex of the chloride with free antimony, (a). When scratched or heated, explosive antimony instantly undergoes transformation with evolution of heat, (b).



C. C. Coffin and S. Johnston, *Proc. Roy. Soc. (London)*, **146A**, 564 (1934)

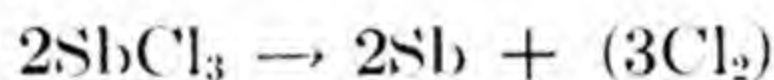
C. C. Coffin, *ibid.* **152A**, 47 (1935)

110

 SbCl_3

I-849

Bright crystals of antimony may be formed by electrolysis of the chloride dissolved in methyl alcohol.



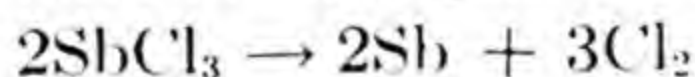
L. Kahlenberg, *J. Phys. Chem.*, **4**, 349 (1900)

7

 SbCl_3

I-850

A solution of antimony trichloride when electrolyzed forms amorphous antimony and does not form an amalgam with a mercury cathode.



G. Gore, *Trans. Roy. Soc. (London)*, **149**, 807 (1860)

Ref., *Ibid.*, **148**, 185 (1860)

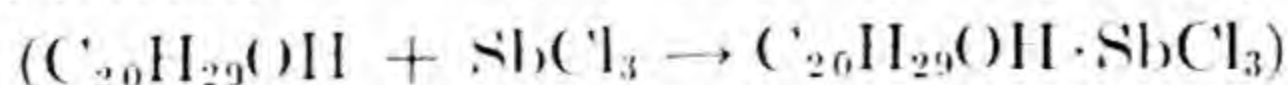
105

 SbCl_3

Vitamin A

I-851

Antimony trichloride dissolved in chloroform at 40°C, cooled to 20°C and decanted. Vitamin A in the unsaponifiable oil fraction is also dissolved in chloroform, and 0.2 cc. placed in a test tube 1 centimeter in diameter to which are added 1.8 cc of the antimony trichloride reagent very rapidly. A blue color develops immediately and may be compared with reference standard for assay of potency.



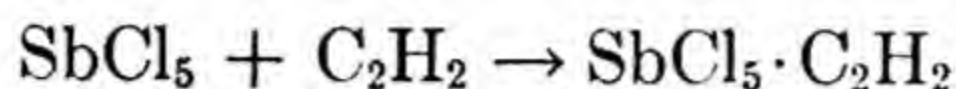
Black, et al., *J. Am. Pharm. Assn.*, **27**, 199 (1938)

112



I-852

When a current of dry acetylene is passed over antimony pentachloride an addition reaction takes place with evolution of heat.



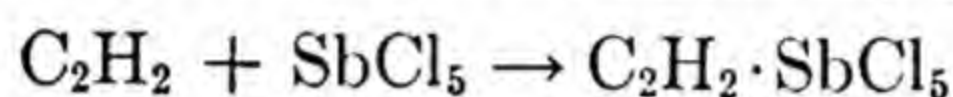
Bertholet and Jungfleisch, *Compt. rend.*, **69**, 543 (1869)

29



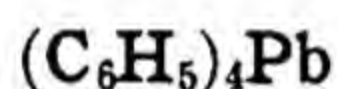
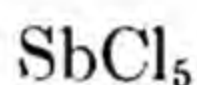
I-853

Acetylene reacts with antimony pentachloride when the two are heated in the absence of air to form acetylenic antimony pentachloride.



Berthelot and Jungfleisch, *Ann.*, **7**, suppl., 252 (1870)

13



I-854

A mixture of lead tetraphenyl and antimony pentachloride in carbon disulfide is heated for one hour and filtered when still hot. The residue consists of lead diphenyl-chloride and diphenyl-antimony-trichloride. The latter is also contained in the filtrate.



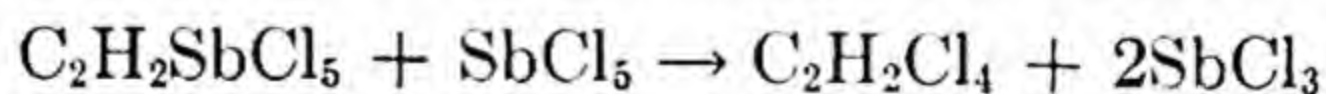
Goddard, Ashley and Evans, *J. Chem. Soc.*, (London), **121**, 980 (1922)

48



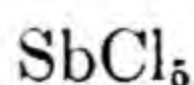
I-855

If acetylenic antimony pentachloride is heated with antimony pentachloride, tetrachloroethane and antimony trichloride are formed.



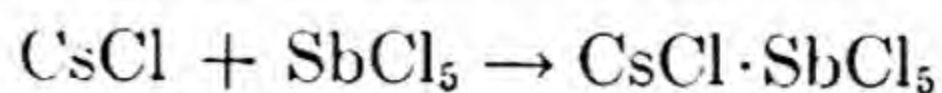
Berthelot and Jungfleisch, *Ann.*, **7**, 253 (1870)

13



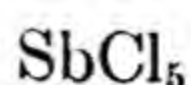
I-856

Mixed solutions of cesium chloride and antimony pentachloride yield white, lustrous prisms of the 1:1 double chloride.



C. Setterberg, *K. Sv. Vet. Akad. Handl., Öfvers.*, **39**, No. 6, 27 (1882)

10

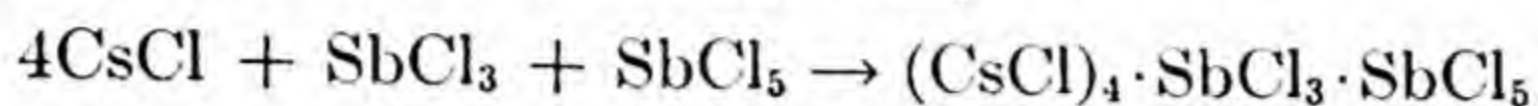


CsCl

I-857

SbCl₃

When an excess of cesium chloride is boiled with antimony pentachloride and with antimony trichloride in strong hydrochloric acid very small black, short prisms form, 4:1:1 triple chloride of cesium and antimony (trichloride and pentachloride).



C. Setterberg., K. Sv. Vet. Akad. Handl., Öfvers., **39**, No. 6, 28 (1882)

10



HI

I-858

Hydriodic acid reacts with antimony pentachloride yielding antimony trichloride, hydrochloric acid and iodine.



G. K. Bergh, Sv. Farm. Tidskr., **8**, 338 (1904)

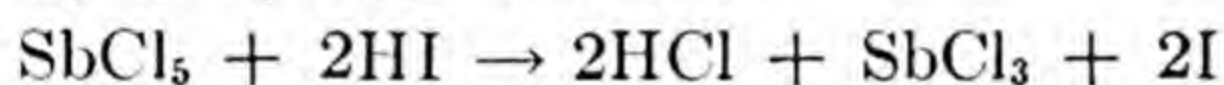
10



HI

I-859

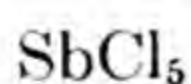
Antimonic chloride liberates iodine from hydriodic acid in the presence of a large quantity of hydrochloric acid.



H. Giraud, Bull. Soc. Chim., **46**, 504

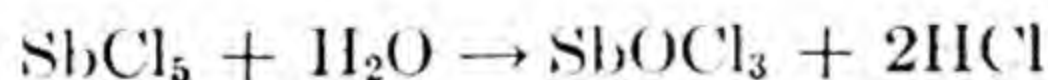
Ref., M. L., J. Am. Chem. Soc., **8**, 178 (1886)

1

H₂O

I-860

Antimonyl chloride is formed when antimony pentachloride reacts with water.



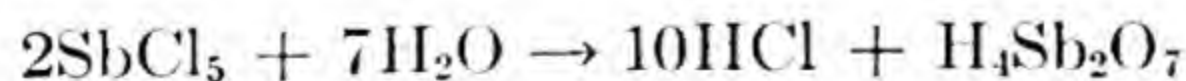
H. Daubrawa, Ann., **186**, 122 (1877)

25

H₂O

I-861

Pyroantimonic acid is obtained when antimony pentachloride is treated with water.



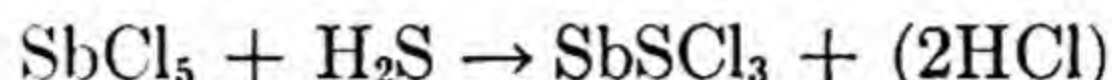
Fremy, J. prakt. Chem., **29**, 86 (1877)

Ref., H. Daubrawa, Ann., **186**, 113 (1877)

25

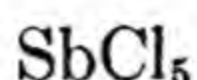
**H₂S****I-862**

Antimony thiochloride is formed when antimony pentachloride reacts with liquid hydrogen sulfide at all temperatures.

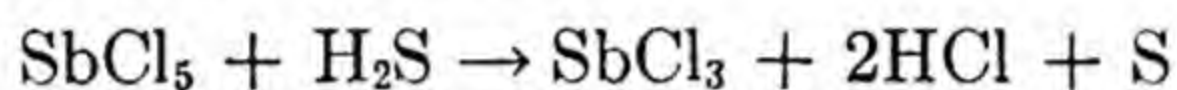


Ralston and Wilkinson, *J. Am. Chem. Soc.*, **50**, 262 (1928)

1

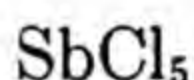
**H₂S****I-863**

Hydrogen sulfide reduces antimony pentachloride to antimony trichloride with formation of sulfur.

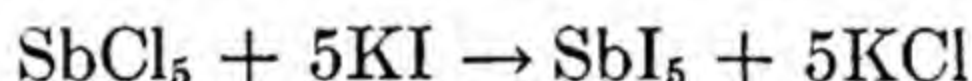


G. K. Bergh, *Sv. Farm. Tidskr.*, **8**, 353 (1904)

10

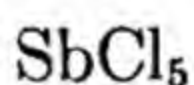
**KI****I-864**

Antimony pentiodide is formed copiously by heating antimony pentachloride and potassium iodide in a sealed tube at 120–140°C.

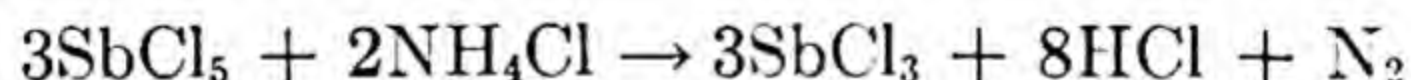


P. Fireman and E. G. Portner, *J. Phys. Chem.*, **8**, 500 (1904)

7

**NH₄Cl****I-865**

Antimony pentachloride yields the trichloride when heated with ammonium chloride at 400°.

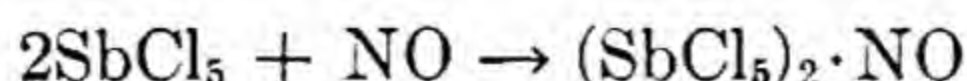


P. Fireman, *J. Am. Chem. Soc.*, **26**, 742 (1904)

1

**NO****I-866**

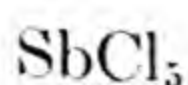
Antimony pentachloride combines directly with nitric oxide when heated at 100° in a sealed tube for several hours.



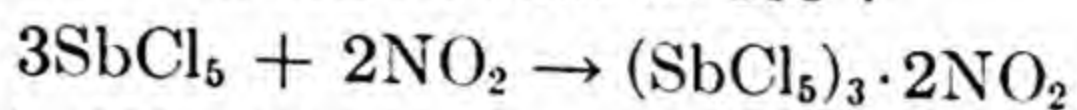
Besson, *Compt. rend.*, **108**, 1012

Ref., *J. Chem. Soc. (London)*, **56**, 834 (1889)

25

**NO₂****I-867**

Pale yellow crystals are formed when antimony pentachloride combines with nitrogen dioxide in a sealed tube at 100°.



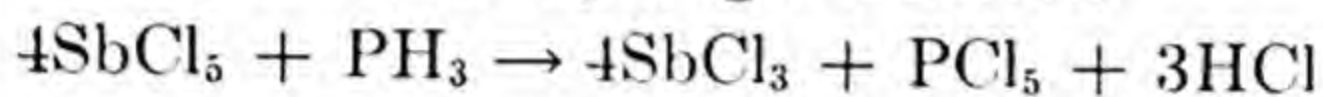
Besson, *Compt. rend.*, **108**, 1012

Ref., *J. Chem. Soc. (London)*, **56**, 834 (1899)

25

**PH₃****I-868**

Antimonic chloride reacts with phosphine to form antimonous chloride, phosphorus pentachloride and hydrogen chloride.



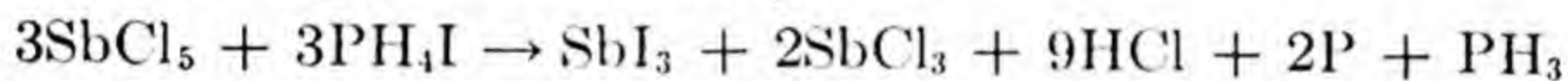
Jenacsche, *Z. f. Medicin u. Naturwis.*, **5**, 158

Ref., *R. Mahn, Am. Chem. J.*, **30**, 124 (1903)

13

**PH₄I****I-869**

If antimony pentachloride and phosphonium iodide are so arranged in a sealed tube that the substances only come in contact when heated, then the following reaction takes place.



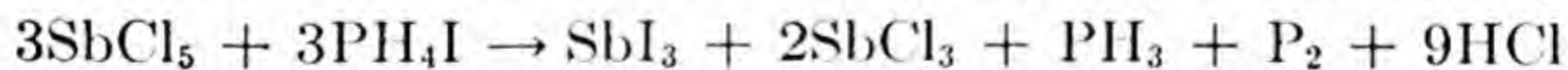
P. Fireman, *Am. Chem. J.*, **30**, 118 (1903).

Ref., *ibid.*, *J. Am. Chem. Soc.*, **26**, 742 (1904)

44

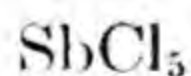
**PH₄I****I-870**

When phosphonium iodide and antimony pentachloride are heated in a sealed tube a reaction takes place yielding antimonous chloride, antimonous iodide, hydrochloric acid, hydrogen phosphide and phosphorus.

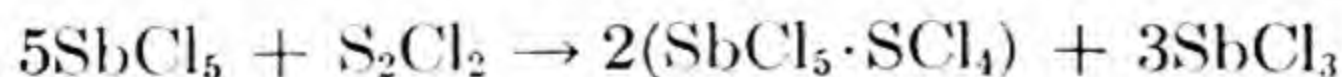


Ernestine and Fireman, *Am. Chem. J.*, **30**, 118 (1903)

21

**S₂Cl₂****I-871**

A double salt is formed when antimony pentachloride is mixed with sulfur monochloride and allowed to stand in a desiccator.



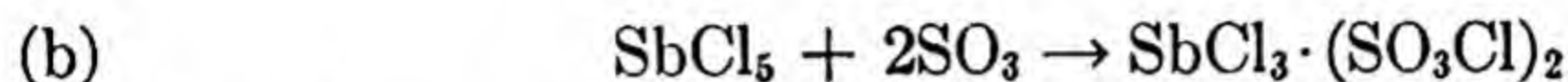
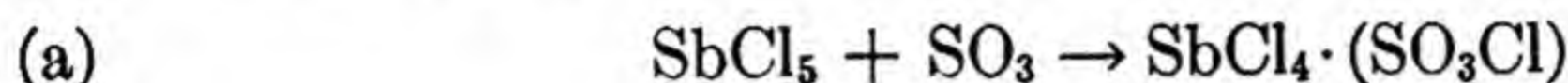
J. R. Partington, *J. Chem. Soc. (London)*, 2576 (1929)

25

SbCl₅SO₃

I-872

Mixing solutions of SbCl₅ and SO₃ in sulfonyl chloride yields a white crystalline product, the composition of which indicates a mixture of SbCl₄·(SO₃Cl) and SbCl₃·(SO₃Cl)₂; depending on the proportion of reagents used. Either form can be predominant.



A. I. Lichacheva, J. Gen. Chem. (USSR), 7, 960 (1937)

60

SbCl₅

Sb

I-873

Antimony reduces antimony pentachloride completely to antimony trichloride.



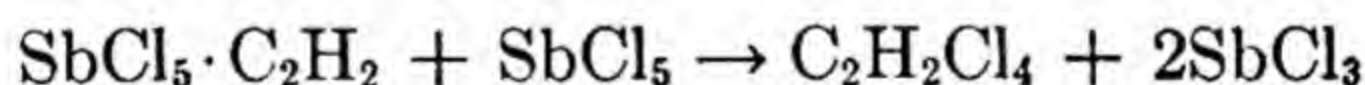
H. C. Boehmer, J. R. Gordon and C. W. Simmons, Can. Chem. J., 4, 171 (1920)

15

SbCl₅SbCl₅·C₂H₂

I-874

When acetylene-antimony pentachloride complex is heated in the presence of an excess of antimony pentachloride, a violent reaction takes place, giving antimony trichloride and tetrachloroethane.



Berthelot and Jungfleisch, Compt. Rend., 69, 543 (1869)

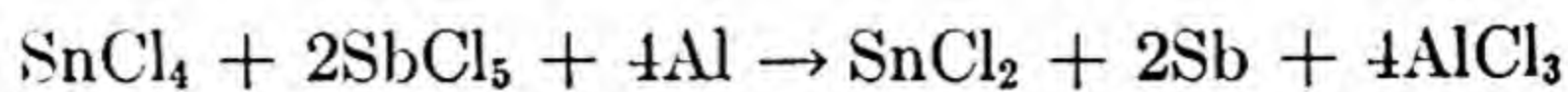
29

SbCl₅SnCl₄

I-875

Al

In a normal hydrochloric acid solution of tin and antimony chlorides aluminum will completely precipitate antimony in the metallic state, and will reduce the stannic to stannous chloride.



J. A. Sanchez, Bull. Soc. Chim. (IV), 7, 891 (1910)

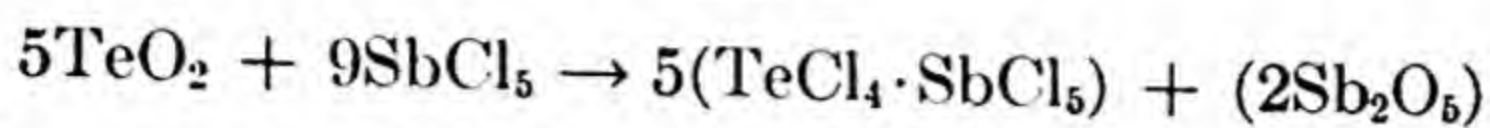
31



TeO₂

I-876

Antimony pentachloride reacts with tellurium dioxide in the cold, forming the compound shown below.



V. Lenher, J. Am. Chem. Soc., **30**, 740 (1908)

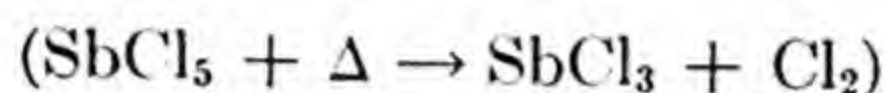
1



Δ

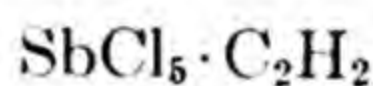
I-877

Antimony pentachloride, a colorless or slightly yellowish liquid which fumes in air, and is heavier than water, disintegrates into antimony trichloride and chlorine at 140°C and therefore is used to introduce chlorine into organic compounds.



C. Hardy, Chem. Ind., **38**, 364 (1936)

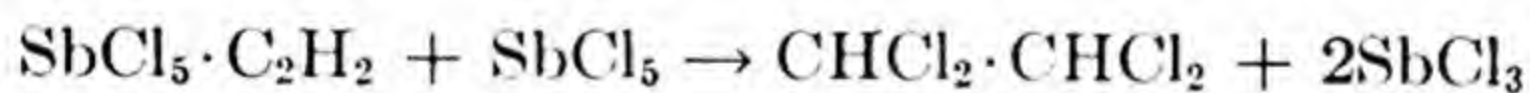
84



SbCl₅

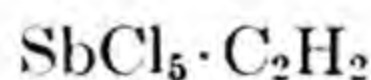
I-878

When the addition product of acetylene and antimony pentachloride is heated with an excess of antimony pentachloride, 1, 2-tetrachloroethane and antimony trichloride are formed.



Berthelot and Jungfleisch,
Ref., Ch. Friedel, Ber., **2**, 565 (1869)

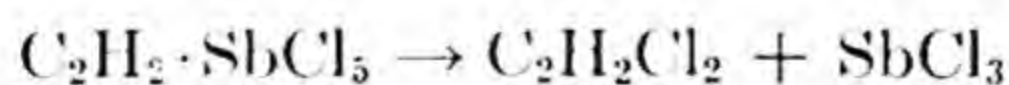
11



Δ

I-879

When acetylene-antimony pentachloride complex is heated, an energetic reaction occurs in which dichloroethylene and antimony trichloride are formed.



Berthelot and Jungfleisch, Compt. Rend., **69**, 543 (1869)
Ref., Berthelot and Jungfleisch, Ann., **7**, supp. 253 (1870)

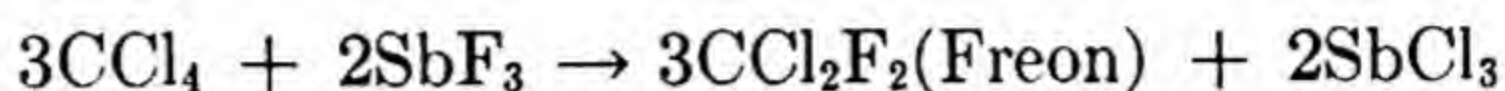
29

13



I-880

A general method for commercial synthesis of refrigerants, solvents and dye intermediates is the replacement of a halogen atom by fluorine through reaction with anhydrous antimony trifluoride with a catalyst, usually SbCl₅.



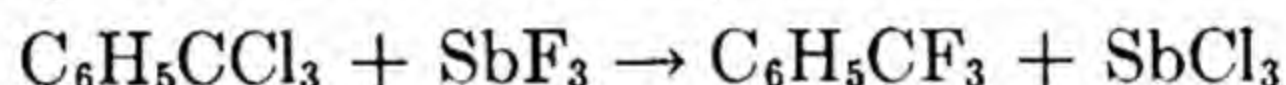
Reed and Finger, Chem. Ind., **39**, 579 (1936)

84



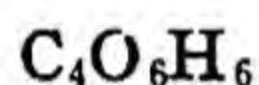
I-881

A general method for commercial synthesis of refrigerants, solvents, dye intermediates, etc., is by the introduction of fluorine into an aromatic nucleus by means of antimony trifluoride.



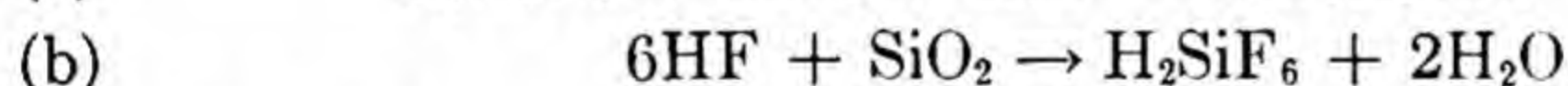
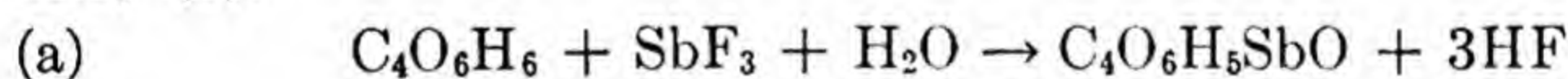
Reed and Finger, Chem. Ind., **39**, 579 (1936)

84



I-882

Antimony fluoride is slowly hydrolyzed in a solution of tartaric acid, (a). In a glass vessel the reaction leads to the formation of fluosilicic acid, (b).



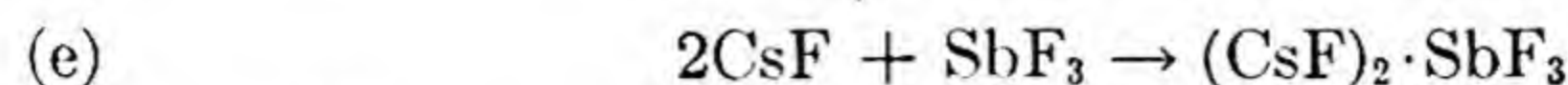
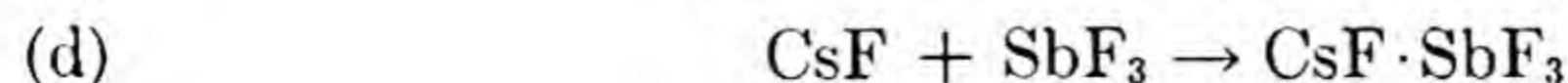
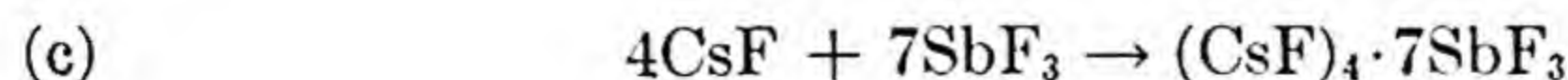
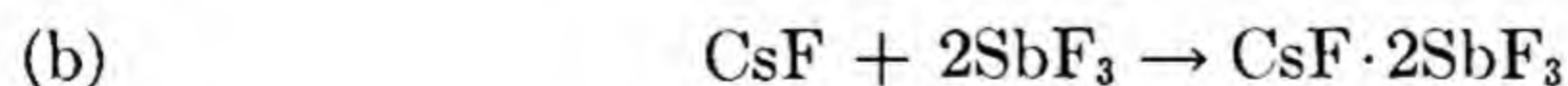
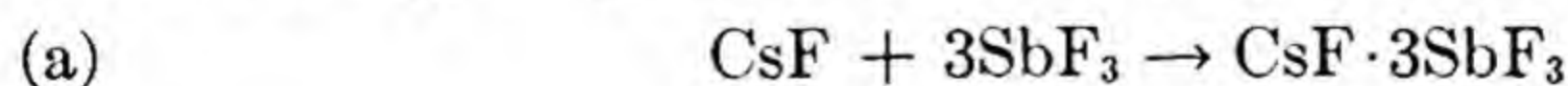
Yeu Ki Heng, J. Chim. phys., **33**, 356 (1936)

69



I-883

A series of double salts of cesium and antimony result when solutions of antimonous fluoride and cesium fluoride with some free hydrofluoric acid are brought together in varying proportions.



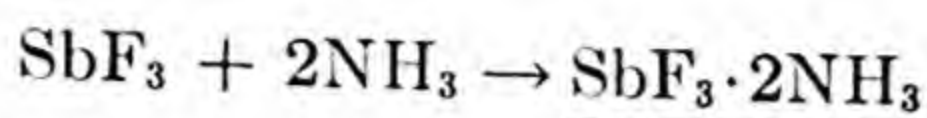
Wells and Metzger, Am. J. Sci., **161**, 451

Ref., J. Am. Chem. Soc., **23**, 199 (1901)

1

NH₃**SbF₃****I-884**

A yellow powder is obtained when antimony trifluoride reacts with liquid ammonia.



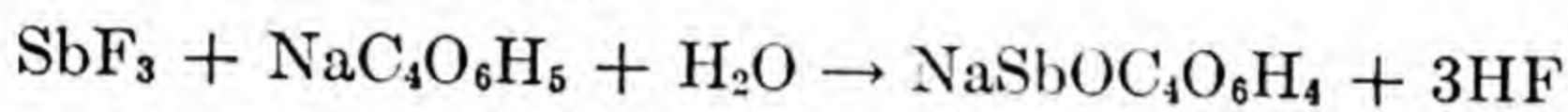
Ruff, Ber., **39**, 4310 (1906)

Ref., J. Chem. Soc. (London), **92**, 99 (1907)

1

SbF₃**NaC₄O₆H₅****I-885**

Tartar emetic is formed when antimony trifluoride is dissolved in a solution of sodium tartrate:

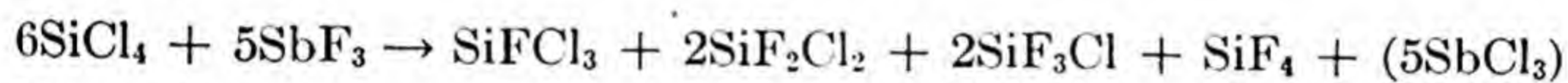


Yeu Ki Heng, J. Chim. phys., **33**, 356 (1936)

69

SbF₃**SiCl₄****1-886**

Fluochlorides of silicon are obtained when antimony trifluoride reacts with silicon tetrachloride in presence of antimony pentachloride as catalyst.

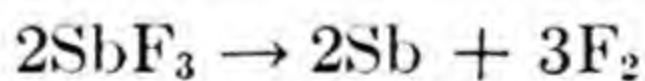


Booth and Swinehart, J. Am. Chem. Soc., **54**, 4751 (1932)

1

SbF₃**ε****I-887**

Antimony trifluoride electrolyzed in the presence of an excess of hydrofluoric acid produced gray, crystalline antimony.

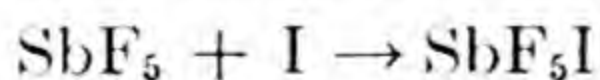


G. Gore, Trans. Roy. Soc. (London), **149**, 808 (1860)

105

SbF₅**I****I-888**

A dark brown compound is formed when antimony pentafluoride is heated with iodine above the boiling point of iodine.



Ruff, Ber., **39**, 4310 (1906)

Ref., J. Chem. Soc. (London), **92**, 98 (1907)

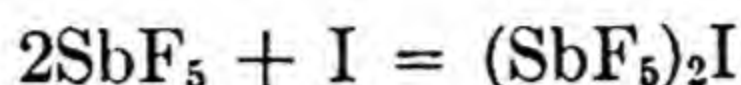
1

SbF₅

I

I-889

A dark bluish-green crystalline mass is formed when a mixture containing iodine and an excess of antimony pentafluoride is heated to 160–220°.



Ruff, Ber., **39**, 4310 (1906)

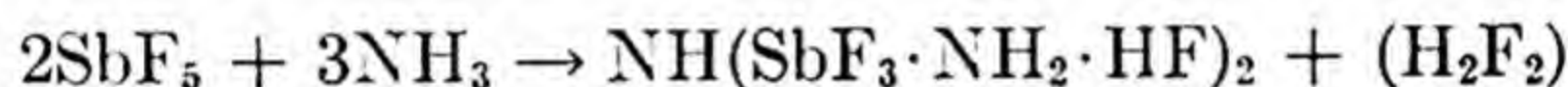
Ref., J. Chem. Soc. (London), **92**, 98 (1907)

1

SbF₅NH₃

I-890

Diamino-diantimony-trifluoroimide dihydrofluoride, a white powder, is formed when antimony pentafluoride is treated with liquid ammonia at 100°C., in a platinum tube.



Ruff, Ber., **39**, 4310 (1906)

Ref., J. Chem. Soc. (London), **92**, 98 (1907)

1

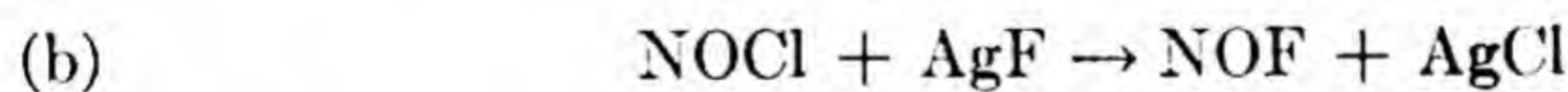
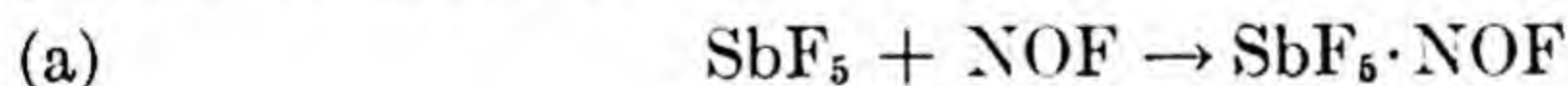
SbF₅

NOCl

I-891

AgF

Antimony pentafluoride will react with nitrosyl fluoride yielding a colorless, crystalline addition product, (a). The nitrosyl fluoride is prepared by the reaction of nitrosyl chloride with silver fluoride at a temperature of 250–280°.



O. Ruff, Z. anorg. Chem., **58**, 325 (1908)

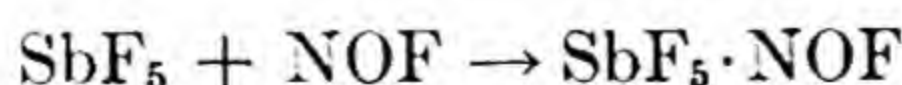
28

SbF₅

NOF

I-892

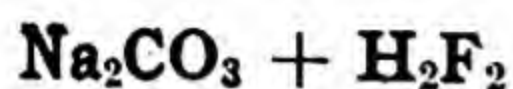
A double compound results when nitrosyl fluoride reacts with antimony pentafluoride.



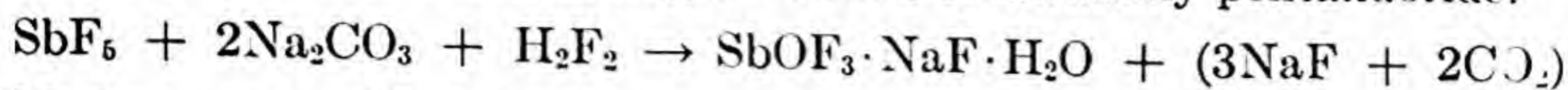
Ruff., Z. anorg. Chem., **58**, 325 (1908)

Ref., J. Chem. Soc. (London), **94**, 584 (1908)

1

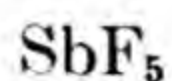
**I-893**

Small crystals separate when sodium carbonate is added to an excess of hydrofluoric acid containing a solution of antimony pentafluoride.

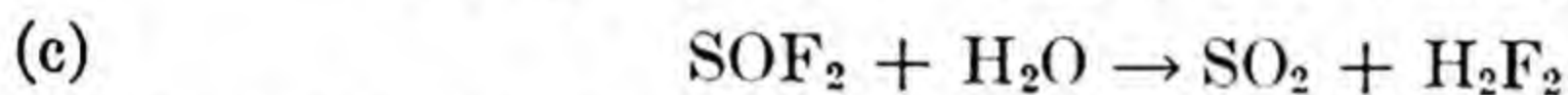
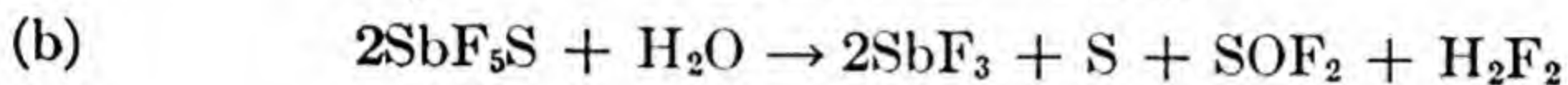


Marignac, Ann., **145**, 245 (1868)

1

**S****I-894**

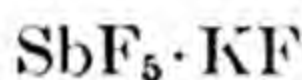
A dark blue compound is formed when sulfur dissolves in antimony pentafluoride, which decomposes in the presence of moisture.



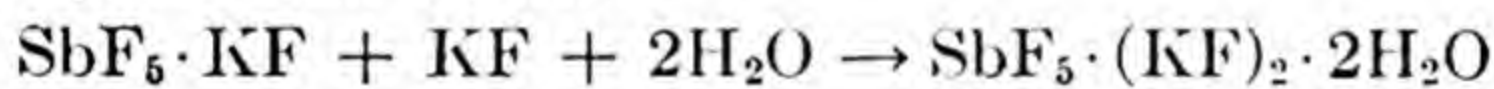
Ruff, Ber., **39**, 4310 (1906)

Ref., J. Chem. Soc. (London), **92**, 98 (1907)

1

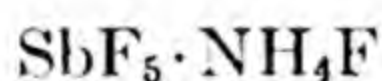
**KF****I-895**

Beautiful shining crystals are obtained when SbF₅·KF is treated with an excess of potassium fluoride.



Marignac, Ann., **145**, 243 (1868)

1

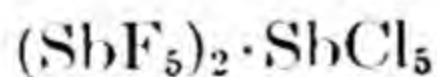
**NH₄F****I-896**

Rectangular leaves are obtained when SbF₅·NH₄F is dissolved in an excess of ammonium fluoride.

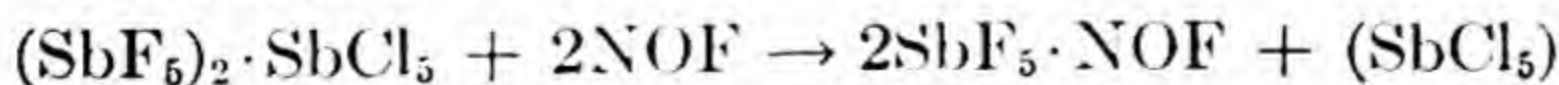


Marignac, Ann., **145**, 247 (1868)

1

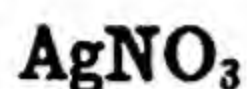
**NOF****I-897**

A double compound has been made by the action of nitrosyl fluoride on antimony chlorofluoride.



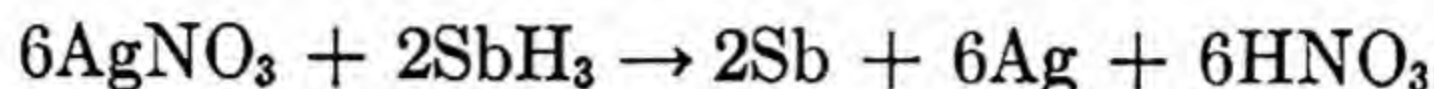
Otto Ruff, Z. anorg. Chem., **58**, 325 (1908)

25



I-898

Silver nitrate in the presence of some dilute hydrochloric acid absorbs stibine to produce antimony, silver, and nitric acid.



Carmelo Russo, *Gazz. chim. ital.*, **34**¹, 197 (1904)

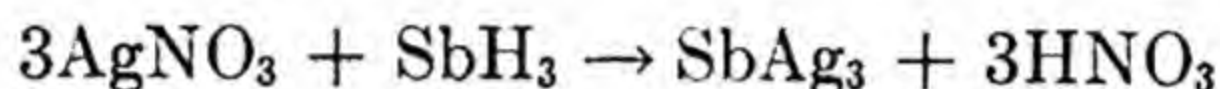
21



I-899

Stibine is completely decomposed by silver nitrate, the reaction products being nitric acid and silver antimonide.

This reaction forms the basis of a convenient method for estimating stibine in a gaseous mixture.



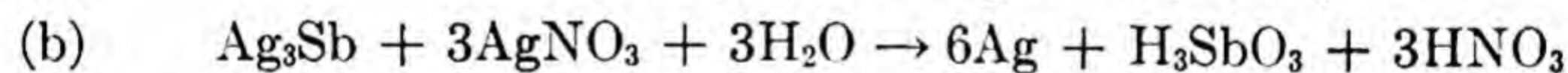
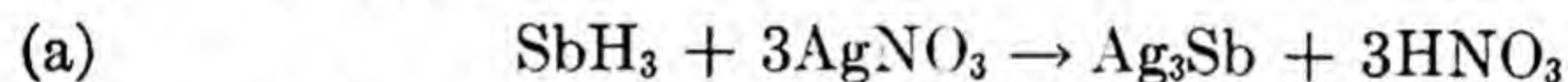
H. J. S. Sand, E. J. Weeks and S. W. Worrell, *J. Chem. Soc.*, **123**, 458 (1923)

48



I-900

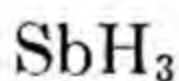
Metallic silver and antimonous acid are produced when stibine reacts with silver nitrate.



Reckleben, *Ber.*, **42**, 1458 (1909)

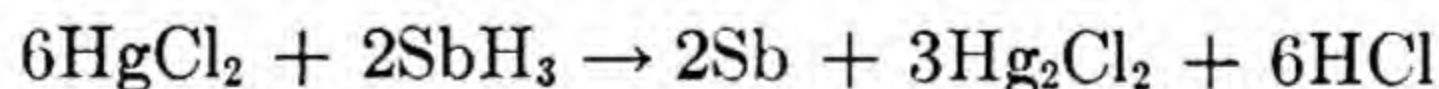
Ref., J. L. Howe, *J. Am. Chem. Soc.*, **31**, 1297 (1909)

1



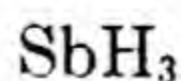
I-901

Stibine, when passed over a paper strip wet with mercuric chloride solution, deposits gray-brown flecks of free antimony. Calomel and hydrochloric acid are formed at the same time.



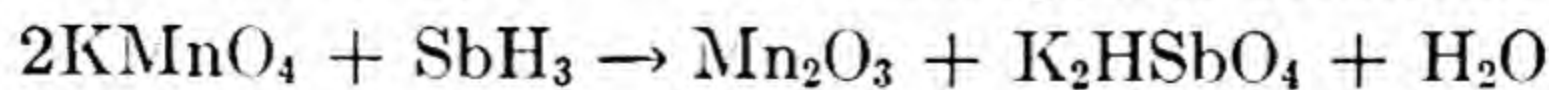
Mayencon, Bergeret and A. Henninger, *Ber.*, **7**, 1444 (1874)

11



I-902

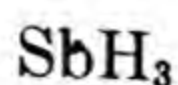
Gaseous stibine reduces potassium permanganate solution.



Jones, *J. Chem. Soc. (London)*, **33**, 98 (1878)

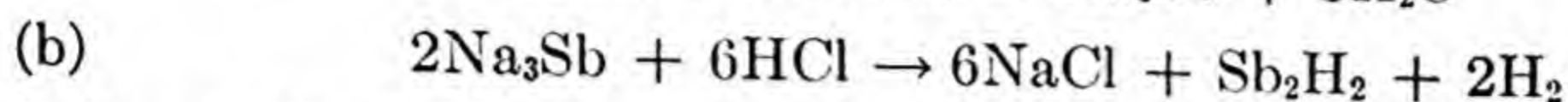
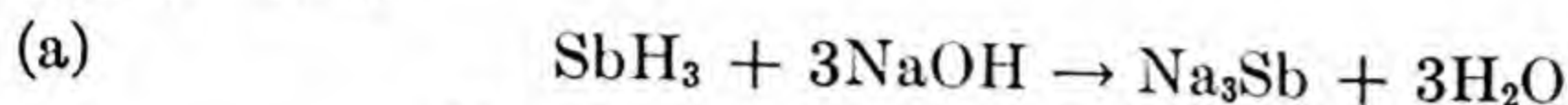
91

NaOH



I-903

Solid antimony hydride is formed when gaseous antimony hydride (stibine) acts upon solid sodium hydroxide and when the resulting greenish compound is decomposed by means of water or diluted hydrochloric acid.



G. Druce, *Chem. List.*, **19**, 156 (1925)

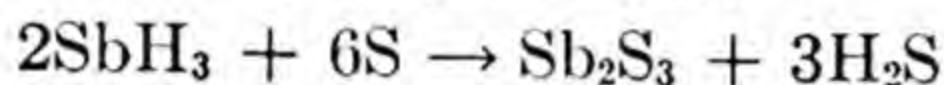
5

S



I-904

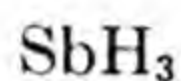
Antimony hydride and sulfur under normal conditions in the sunlight give antimony sulfide and hydrogen sulfide.



Gerstl, *Gazz. Chim. ital.*, **6**, 509 (1876)

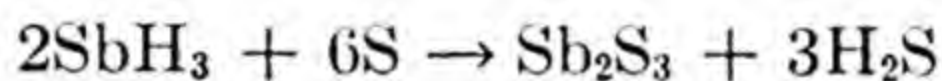
21

S



I-905

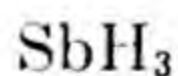
Stibine reacts with sulfur at 100°C to form the sulfide and hydrogen sulfide. The reaction proceeds slowly at first but is quickly accelerated by sunlight.



F. Jones,
Ref., *R. Gerstl., Ber.*, **9**, 588 (1876)

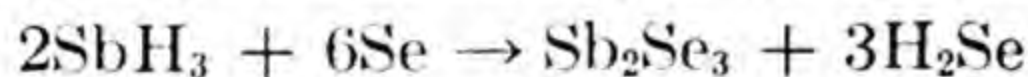
26

Se



I-906

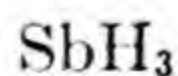
At the temperature of boiling water elementary selenium decomposes stibine into antimony triselenide and hydrogen selenide.



F. Jones, *Chem. News*, **98**, 14 (1908)

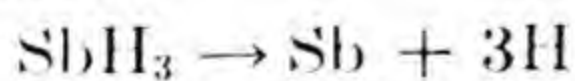
25

e



I-907

Stibine is decomposed by the silent electric discharge in an ozonizer. Metallic antimony is obtained.



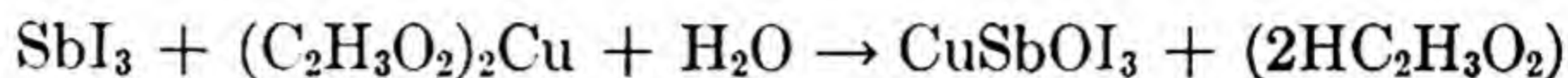
H. Reckleben and J. Scheiber, *Z. anorg. Chem.*, **70**, 275 (1911)

28

SbI₃(C₂H₃O₂)₂Cu

I-908

When antimony triiodide and copper acetate in equimolecular quantities are warmed in moist amyl alcohol on a water bath for 4–6 hours, copper antimony oxyiodide is formed.



Vournazos, *Compt. rend.*, **170**, 1256 (1920)

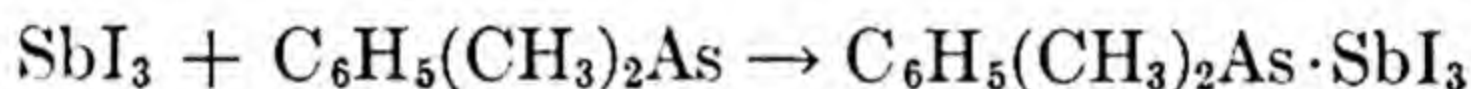
Ref., *J. Chem. Soc. (London)*, **118**, 437 (1920)

25

SbI₃C₆H₅(CH₃)₂As

I-909

Antimony triiodide is dissolved in boiling benzene and then treated with phenyl dimethyl arsine, dissolved in the same solvent. Orange colored prisms separate having a melting point of 165°C.



G. J. Burrows and E. E. Turner, *J. Chem. Soc. (London)*, **119**, 1448 (1921)

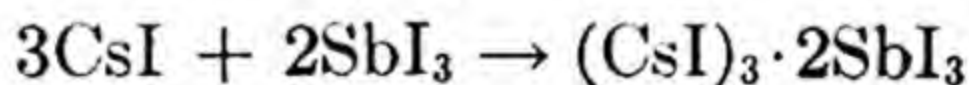
25

SbI₃

CsI

I-910

Cesium antimonous iodide results when solutions of cesium iodide and antimonous iodide are strongly acidified with hydriodic acid and allowed to crystallize.



Wells and Metzger, *Am. J. Sci.*, **161**, 451

Ref., *J. Am. Chem. Soc.*, **23**, 199 (1901)

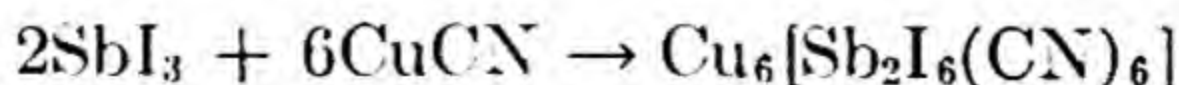
1

SbI₃

CuCN

I-911

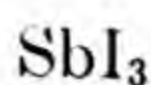
If cuprous cyanide and antimony triiodide are heated together in dry xylene, cuprous antimony iodo-cyanide is formed.



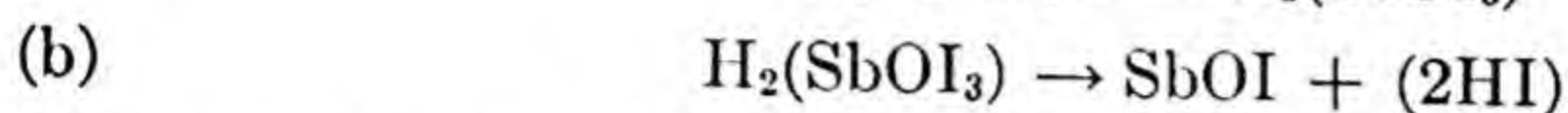
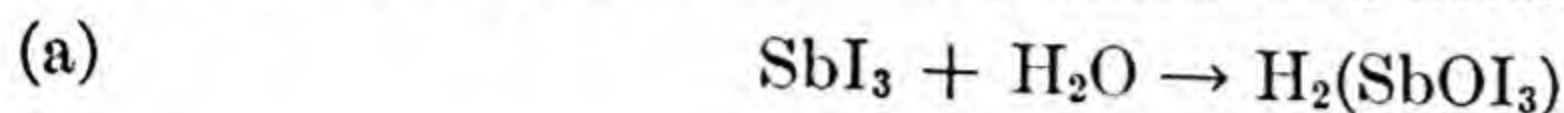
Vournazos, *Compt. rend.*, **170**, 1256 (1920)

Ref., *W. Goddon, J. Chem. Soc.*, **118**, 437 (1920)

25

**HOH****I-912**

An unstable complex acid which soon passes over into antimony oxyiodide is formed when antimony triiodide is decomposed by water.



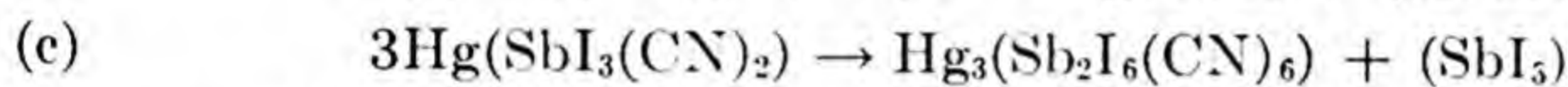
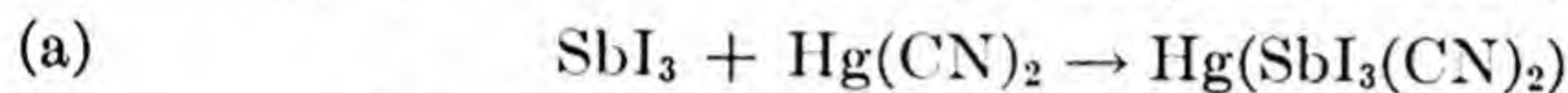
Vournazos, *Compt. rend.*, **170**, 1256 (1920)

Ref., W. Goddon, *J. Chem. Soc.*, **118**, 437 (1920)

25

**Hg(CN)₂****I-913**

If mercury cyanide and antimony triiodide are heated together in dry xylene, mercury antimony iodoecyanide is obtained which on treatment with moist amyl alcohol gives the antimony oxyiodide. If the heating is continued trimercury antimony iodoecyanide is obtained.



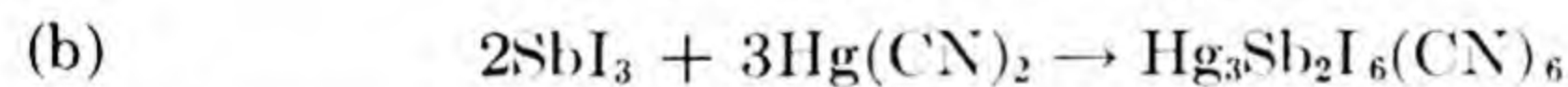
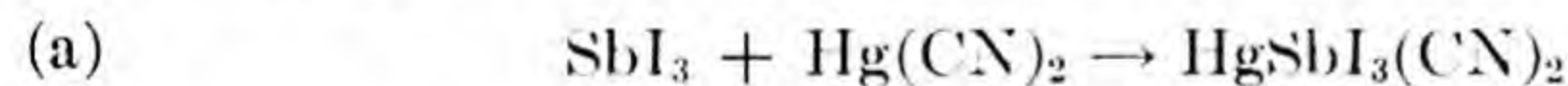
Vournazos, *Compt. rend.*, **170**, 1256 (1920)

Ref., *J. Chem. Soc. (London)*, **118**, 437 (1920)

1

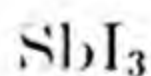
**Hg(CN)₂****I-914**

Complex iodoecyanides are obtained by heating antimony triiodide with mercuric cyanide in dry xylene:

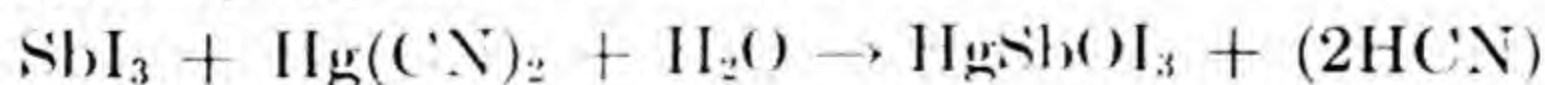


A. C. Vournazos, *Compt. rend.*, **166**, 526 (1918)

44

**Hg(CN)₂****I-915**

When antimony triiodide and mercuric cyanide in equimolecular proportions are warmed in moist amyl alcohol on a water bath for 4-6 hours, mercury antimony oxyiodide is obtained.



Vournazos, *Compt. rend.*, **170**, 1256 (1920)

Ref., *J. Chem. Soc.*, **118**, 437 (1920)

1

SbI₃I₂

I-916

If a solution of antimony triiodide is made alkaline by the addition of an excess of sodium bicarbonate and titrated with 0.1*N* iodine solution, the following reaction takes place.



Beneker, J. Ind. Eng. Chem., **3**, 637 (1911)

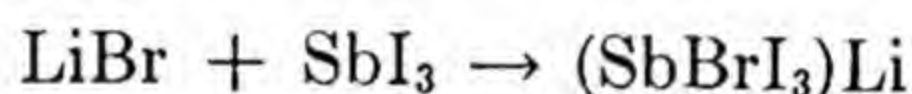
22

SbI₃

LiBr

I-917

Triturate equimolecular quantities of dry lithium bromide and antimony triiodide with a solvent as acetic acid, xylene, etc., then heat on a water bath. Yellow-red crystals of lithium antimoniodobromide are formed.



A. Ch. Vournazos, Compt. rend., **175**, 164-67 (1922)

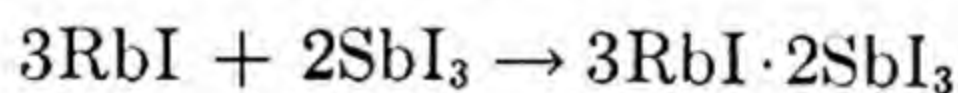
2

SbI₃

RbI

I-918

A solution of rubidium iodide in hydrogen iodide will react with antimony triiodide yielding deep red crystals.



H. L. Wheeler, Z. anorg. Chem., **5**, 253 (1894)

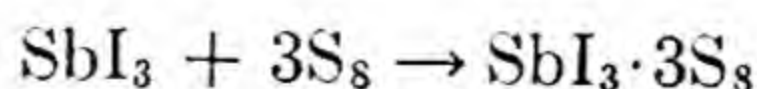
28

SbI₃

S

I-919

Sulfur forms addition compounds with antimony triiodide, when the reactants are mixed in the stoichiometrical proportions in carbon disulfide.

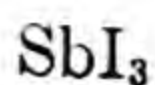


Kleinboldt and Schneider, J. prakt. Chem., **120**, 238 (1929)

Ref., Hertel, Z. physik. Chem., **15B**, 51 (1931)

Ref., C. B. Allsopp, Proc. Roy. Soc. (London), **158A**, 176 (1937)

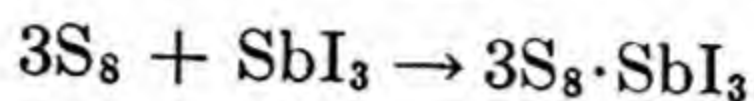
110



S

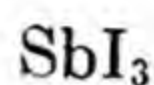
I-920

Approximately 4 times the theoretical quantity of sulfur is treated with antimony triiodide to form long, very fine, bright yellow prisms of the addition compound which melts at 117°.



V. Auger, *Compt. rend.*, **146**, 479 (1908)

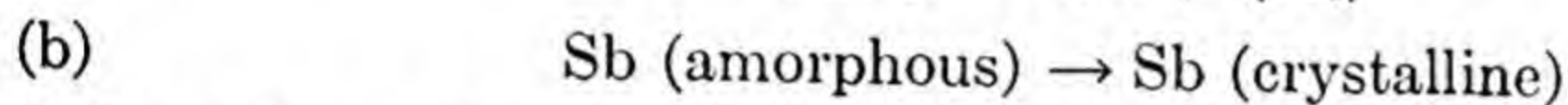
38



e

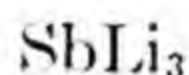
I-921

Antimony triiodide is electrolyzed in the presence of excess hydriodic acid, using an antimony anode. An active form of antimony results which may evolve heat and explode if heated to about 340°F.



G. Gore, *Trans. Roy. Soc. (London)*, **152**, 325 (1863)

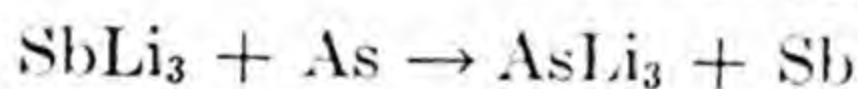
105



As

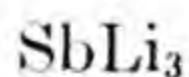
I-922

Lithium antimonide, when heated with arsenic, yields lithium arsenide.



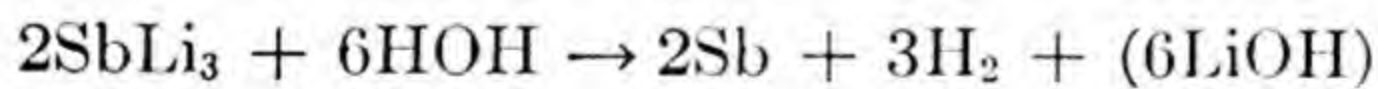
P. Lebeau, *Compt. rend.*, **134**, 284 (1902)

2

H₂O

I-923

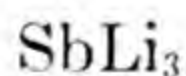
Lithium antimonide is decomposed by water with the formation of antimony and evolution of pure hydrogen.



Paul Lebeau, *Compt. rend.*, **134**, 284 (1902)

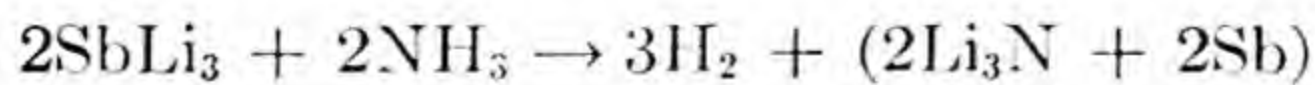
Ref., *J. Chem. Soc. (London)*, **82**, 257 (1902)

1

NH₃

I-924

At red heat lithium antimonide decomposes ammonia, and hydrogen is evolved.



P. Lebeau, *Compt. rend.*, **134**, 284 (1902)

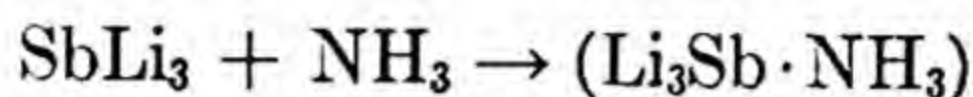
2



NH₃

I-925

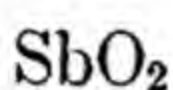
A reddish-brown liquid is formed when lithium antimonide is dissolved in liquid ammonia, which contains the compound shown to be formed in the equation.



Lebeau, Compt. rend., **134**, 284 (1902)

Ref., C. H. Bothamley, J. Chem. Soc., **82**, 257 (1902)

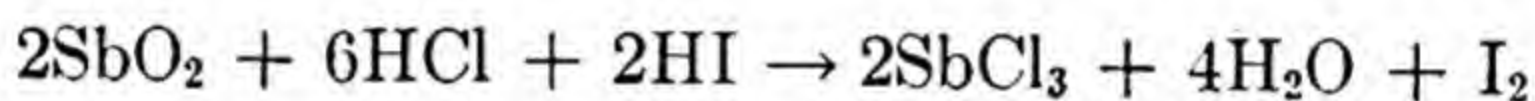
25



HCl

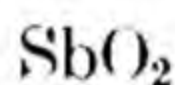
I-926

When heated with concentrated hydrochloric acid and potassium iodide, antimony dioxide yields antimony trichloride and free iodine.



Ref., W. P. S., J. Chem. Soc. (London), **114**, 135 (1918)

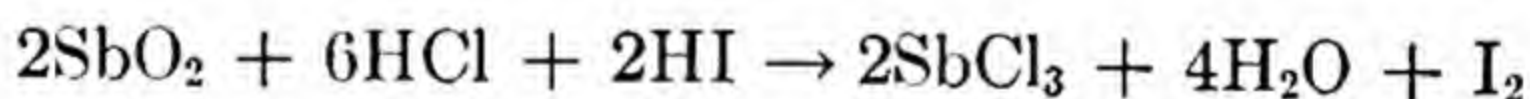
25



HI

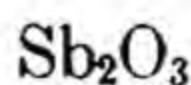
I-927

Iodine is obtained when antimony dioxide is distilled with hydriodic acid in presence of hydrochloric acid.



I. v. Szilágyi, Z. anal. Chem., **57**, 25 (1918)

28

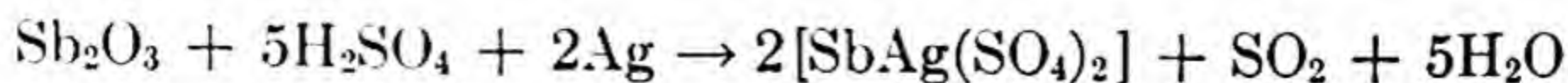


Ag

I-928

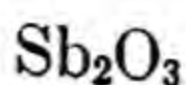
H₂SO₄

A solution of antimony trioxide in concentrated sulfuric acid will react with a solution of metallic silver in sulfuric acid, yielding antimony-silver sulfate.



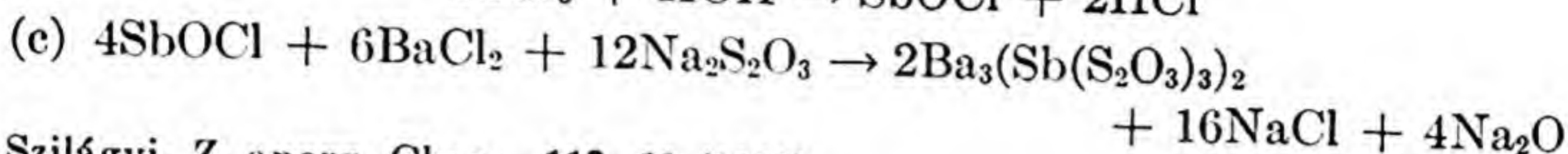
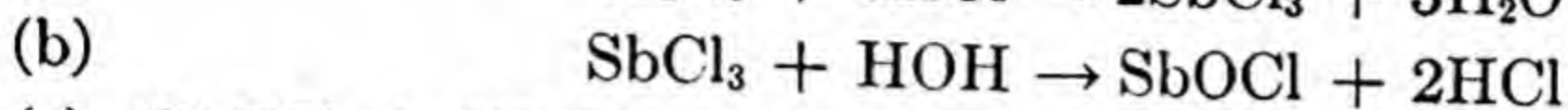
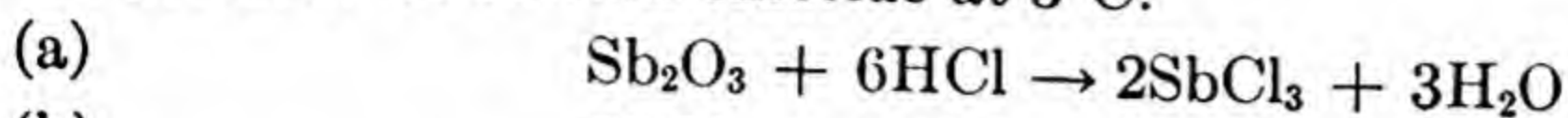
H. Kühl, Z. anorg. Chem., **54**, 256 (1907)

28



I-929

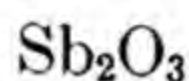
Unstable barium antimony thiosulfate is formed when a hydrochloric acid solution of antimony trioxide is treated with sodium thiosulfate in the presence of barium chloride at 3°C.



Szilágyi, Z. anorg. Chem., **113**, 69 (1920)

Ref., J. Chem. Soc. (London), **120**, 207 (1921)

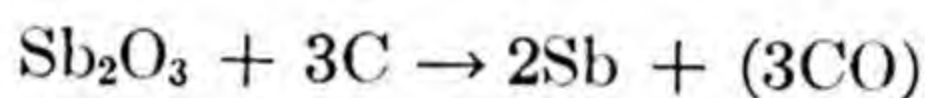
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C

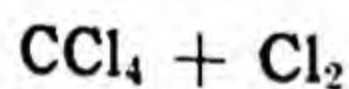
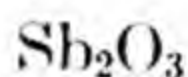
I-930

A powder containing a mixture of antimony trioxide and other materials was mixed with tartar and fused on charcoal. Antimony was formed.



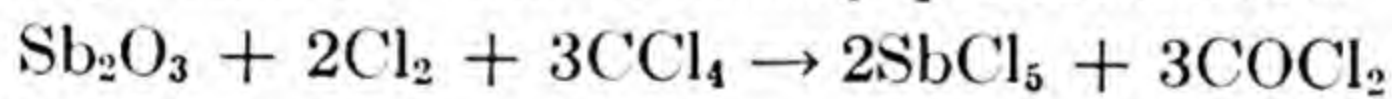
George Pearson, Trans. Roy. Soc. (London), **81**, 319 (1891)

105



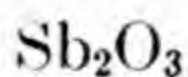
I-931

A chlorine-carbon tetrachloride solution acts on antimony trioxide, forming carbonyl chloride and antimony pentachloride.



Michael and Murphy, Am. Chem. J., **44**, 377 (1910)

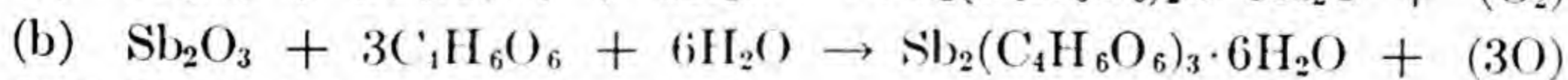
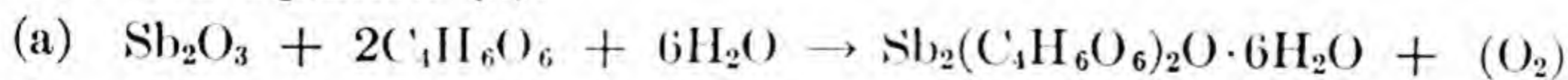
13



I-932

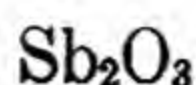
When alcohol is added to a solution of antimony trioxide in a slight excess of tartaric acid in water, basic hydrated antimony tartrate is produced.

When the tartaric acid is in large excess the normal salt is produced as shown in equation (b).



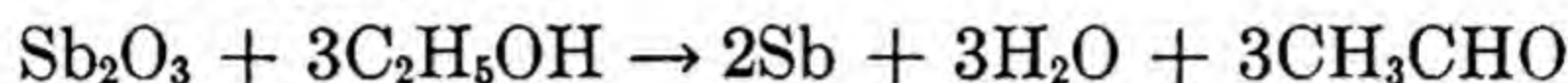
C. S. Evans, Science, **1**, 235 (1883)

73



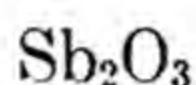
I-933

Antimony trioxide is reduced little by little to the metal by the action of ethyl alcohol vapors at 360° , with formation of water and acetaldehyde. The semi-metallic powder produced has no appreciable catalytic action at this temperature.



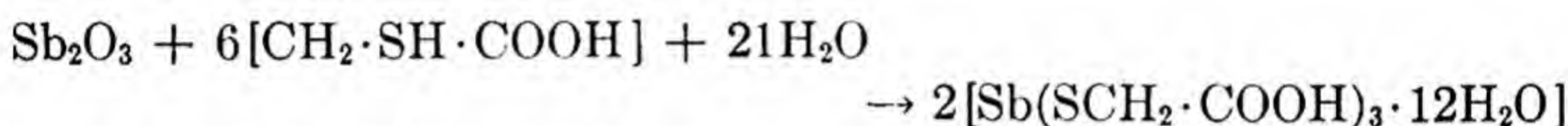
P. Sabatier and A. Mailhe, *Compt. rend.*, **147**, 16 (1908)

38



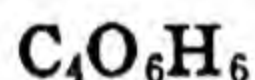
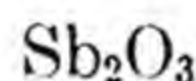
I-934

Colorless crystals are obtained when a heated solution of antimony trioxide in thioglycolic acid is cooled.



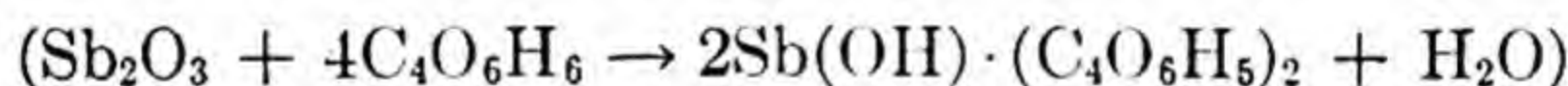
A. Rosenheim and I. Davidsohn, *Z. anorg. Chem.*, **41**, 231 (1904)

28



I-935

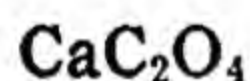
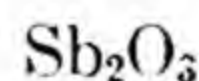
Antimonio-tartaric acid is prepared by dissolving antimony trioxide in an excess of tartaric acid, and removing the excess with acetone.



Blanchetiere, *Bull. soc. chim.*, **27**, 477 (1920)

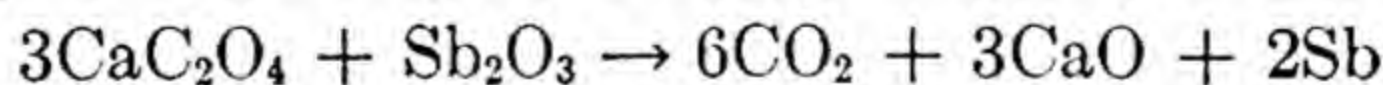
Ref., J. L. Delsal, *J. Chim. phys.*, **35**, 350 (1938)

69



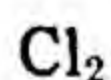
I-936

If one takes three moles of calcium oxalate mixed with one mole of antimony trioxide and heats strongly over a long period one obtains a reduction of part of the oxide according to the equation:



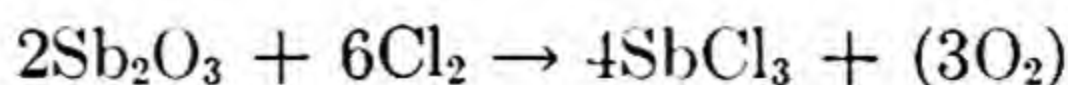
Oechsner de Coninck and Raynaud, *Bull. Soc. Chim.*, [4], **9**, 301 (1911)

31



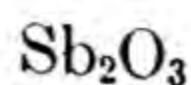
I-937

Chlorine reacts with antimony trioxide below red heat to form antimony trichloride.



Humphry Davy, *Trans. Roy. Soc. (London)*, **101**, 25 (1811)

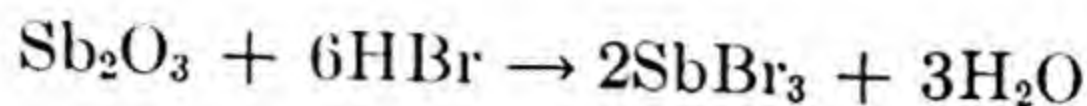
105



HBr

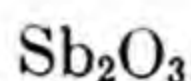
I-938

Antimony trioxide was dissolved in hydrobromic acid, yielding antimony tribromide.



G. Gore, Trans. Roy. Soc. (London), **152**, 323 (1863)

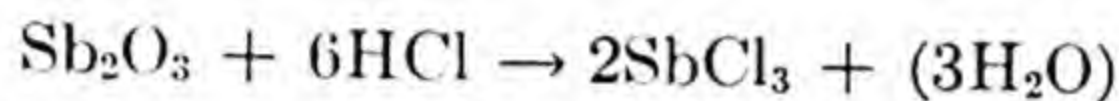
105



HCl

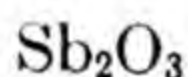
I-939

Antimony trioxide was dissolved in hydrochloric acid, forming antimony trichloride.



George Pearson, Trans. Roy. Soc. (London), **81**, 323 (1891)

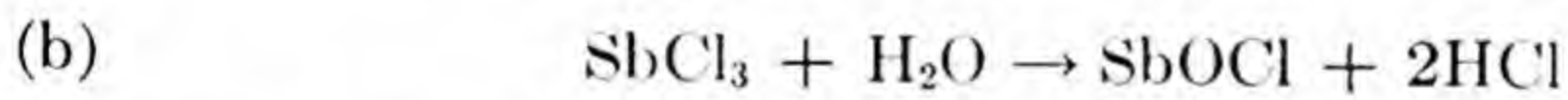
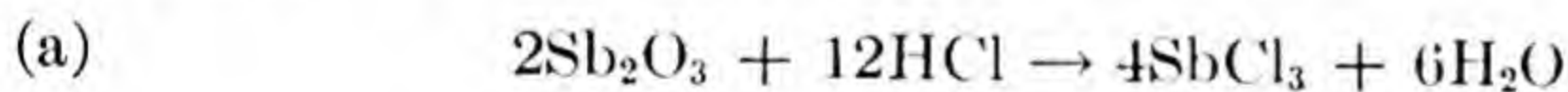
105



HCl

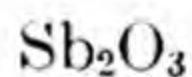
I-940

Antimony oxychloride is precipitated when antimony trioxide dissolved in hydrochloric acid is treated with water.



J. B. Moyer, J. Am. Chem. Soc., **18**, 1032 (1896)

1

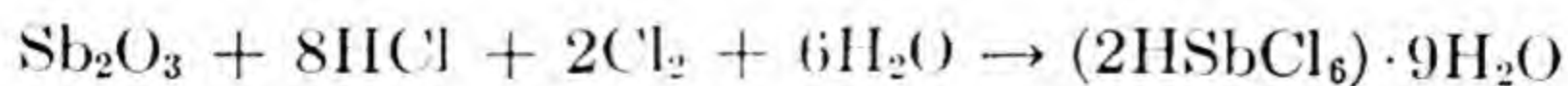


HCl

I-941

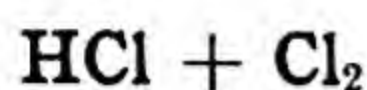
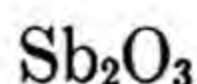
Cl

Dissolve antimony trioxide in concentrated hydrochloric acid. Pass a stream of chlorine gas through the solution. At a temperature of 0° crystals of greenish yellow color, metachloro antimonie acid, are obtained.



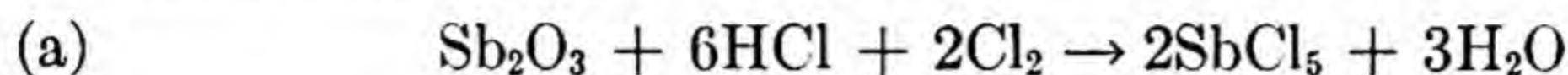
R. F. Weinland and H. Schmid, Z. anorg. Chem., **44**, 37 (1905)

28



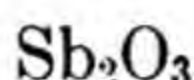
I-942

An acid is produced when antimony pentachloride, obtained by the action of fairly concentrated hydrochloric acid on antimony trioxide, is saturated with dry hydrogen chloride and cooled to 0°C.



Willard and McAlpine, J. Am. Chem. Soc., **43**, 801 (1921)

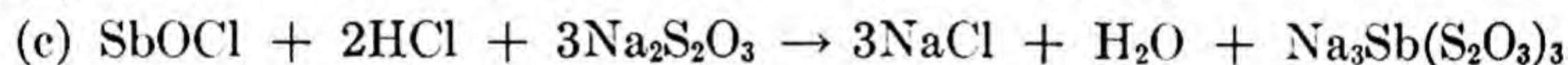
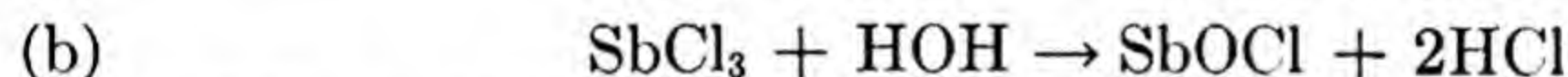
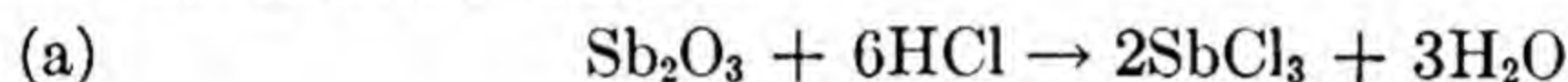
1



I-943



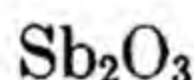
Sodium antimony thiosulfate is formed when a solution of hydrochloric acid and antimony trioxide is treated with sodium thiosulfate at low temperature, (3°C.). The corresponding potassium and rubidium salts are formed when potassium chloride or rubidium chloride is added to the reaction mixture.



Szilágyi, Z. anorg. Chem., **113**, 69 (1920)

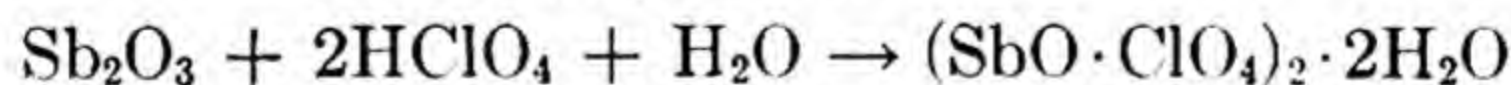
Ref., J. Chem. Soc. (London), **120**, 207 (1921)

1



I-944

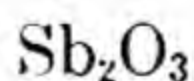
Antimonyl perchlorate is formed in small needles when antimony trioxide is dissolved in hot 70% perchloric acid.



Fichter and Jenny, Helv. Chim. Acta, **6**, 225 (1923)

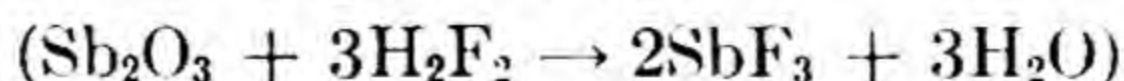
Ref., J. Chem. Soc. (London), **124**, 245 (1923)

1



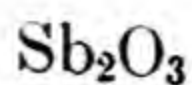
I-945

Antimony trioxide and hydrofluoric acid produce antimony trifluoride which is soluble in cold water without hydrolysis; its great importance lies in the formation of double salts which are used as mordants in dyeing, printing and tanning industries.



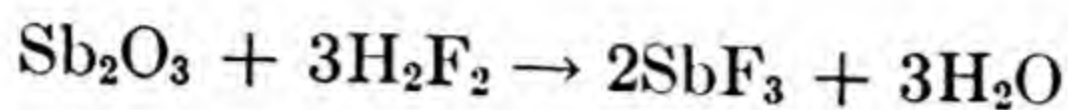
C. Hardy, Chem. Ind., **38**, 364 (1936)

84



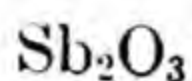
I-946

Antimony trioxide was dissolved in hydrofluoric acid yielding antimony trifluoride.



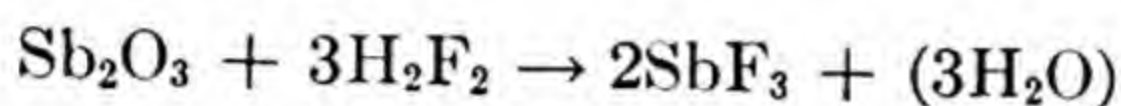
G. Gore, Trans. Roy. Soc. (London), **149**, 808 (1860)

105



I-947

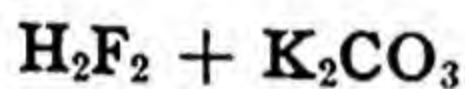
Antimony trifluoride is formed when antimony trioxide is dissolved in aqueous hydrofluoric acid.



Fluckiger, Pogg. Ann., **87**, 245 (1852)

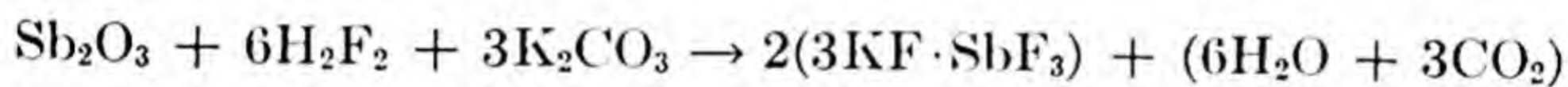
Ref., Ann., **84**, 248 (1852)

1



I-948

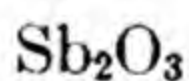
Potassium fluoantimonate is prepared by mixing 153 parts of antimony trioxide with water and dissolving in it an excess of hydrofluoric acid and saturating the resulting mixture with 200 parts of potassium carbonate.



Fluckiger, Pogg. Ann., **87**, 245

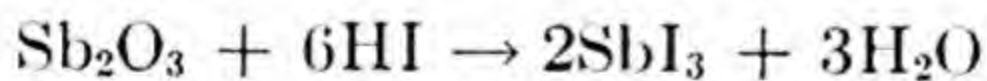
Ref., Ann., **84**, 250 (1852)

1



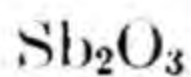
I-949

Antimony trioxide was dissolved in hydriodic acid yielding antimony triiodide.



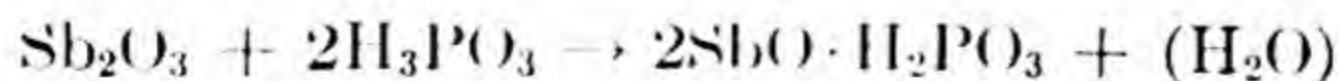
G. Gore, Trans. Roy. Soc. (London), **152**, 325 (1863)

105



I-950

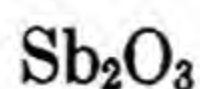
Microscopic needles form when a pure solution of phosphorous acid is added to antimony oxide.



Grutzner, Arch. Pharm., **235**, 693 (1897)

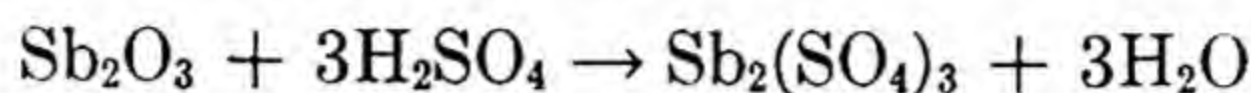
Ref., J. Chem. Soc. (London), **74**, 216 (1898)

1



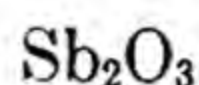
I-951

Antimony trioxide when digested with moderately concentrated sulfuric acid forms antimony sulfate.

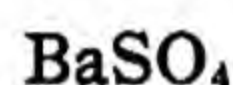


C. Schultz-Sellack, Ber., **4**, 13 (1871)

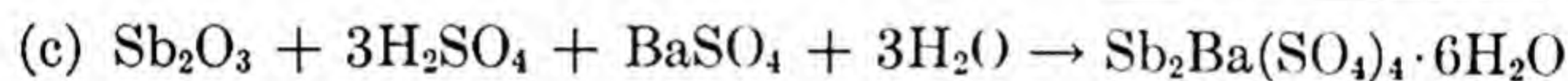
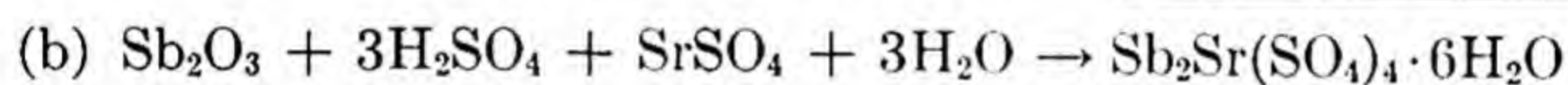
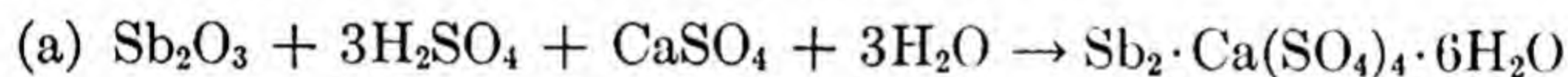
11



I-952

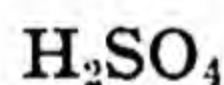
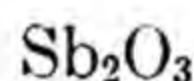


To a solution of 3 grams of antimony trioxide in 150 cc of concentrated sulfuric acid a solution of 4 grams of calcium sulfate in 80 cc of sulfuric acid is added. This mixture is concentrated. After cooling needles of antimony calcium sulfate are obtained. The same type reaction occurs with strontium sulfate and barium sulfate.

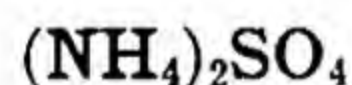
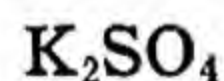
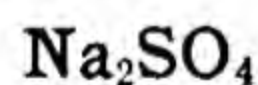


H. Kühl, Z. anorg. Chem., **54**, 256 (1907)

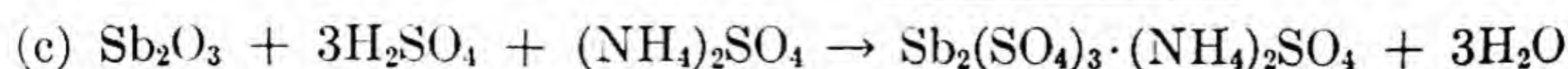
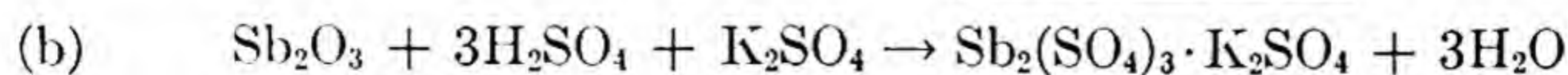
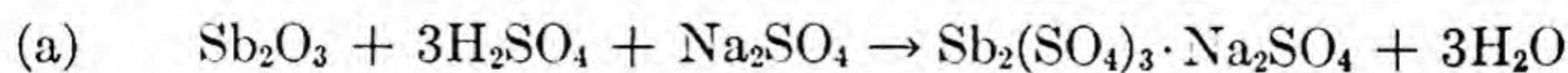
28



I-953



10 grams of antimony trioxide are heated with concentrated sulfuric acid; 5.5 grams of sodium sulfate are added. By cooling this solution needles of antimony-sodium sulfate are obtained. The same type reaction occurs with potassium sulfate and ammonium sulfate.

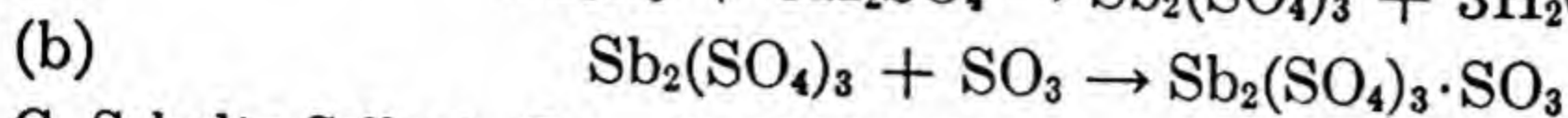
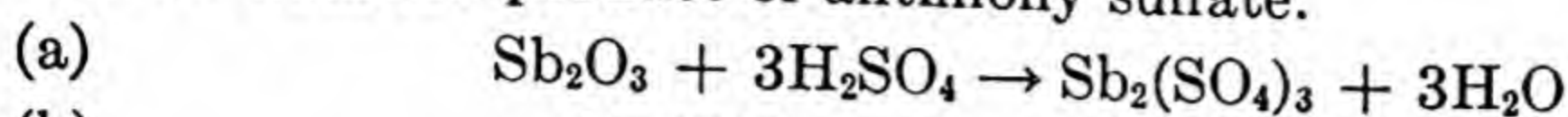


L. Metzl, Z. anorg. Chem., **48**, 140 (1906)

28

H₂SO₄·SO₃**Sb₂O₃****I-954**

Antimony trioxide dissolves in fuming sulfuric acid to form a sulfur trioxide addition product of antimony sulfate.

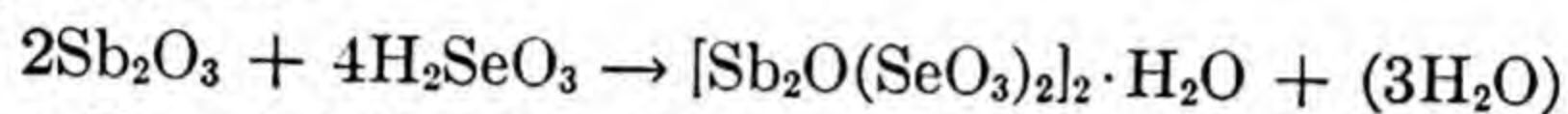


C. Schultz-Sellack, *Ber.*, **4**, 112 (1871)

11

Sb₂O₃**H₂SeO₃****I-955**

Freshly produced antimony trioxide treated with concentrated selenious acid yields white, lustrous, crystalline tablets of a hydrated basic antimony selenite.



L. F. Nilson, *Nova Act. Reg. Soc. Sci. Upsal.*, Series 3, Vol. **9**, No. 7, 111 (1874)

10

Sb₂O₃**I₂****I-956****H₂O**

Antimony trioxide, iodine and water react to form antimony pentoxide and hydriodic acid.

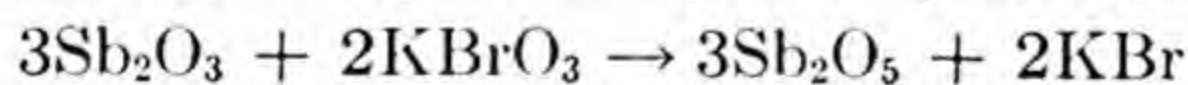


G. F. Bergh, *Sv. Farm. Tidskr.*, **8**, 318 (1904)

10

Sb₂O₃**KBrO₃****I-957**

In the presence of sodium or potassium sulfate, sulfuric acid, hydrochloric acid and a few drops of Poirier's orange, antimony may be quantitatively determined by titrating with potassium bromate.

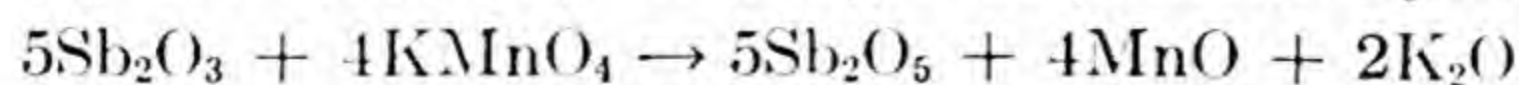


L. Bertiaux, *Bull. Soc. Chim. [IV]*, **27**, 771 (1920)

31

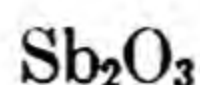
Sb₂O₃**KMnO₄****I-958**

In the presence of sodium or potassium sulfate, sulfuric acid, hydrochloric acid and a few drops of Poirier's orange, antimony may be quantitatively determined by titrating with potassium permanganate.



L. Bertiaux, *Bull. soc. chim [IV]*, **27**, 770 (1920)

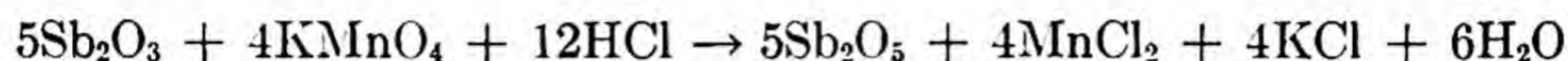
31



I-959

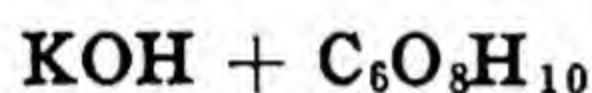
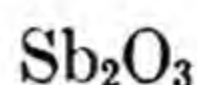


Antimony trioxide is transformed into antimony pentoxide by the action of potassium permanganate and hydrochloric acid on antimony trioxide.



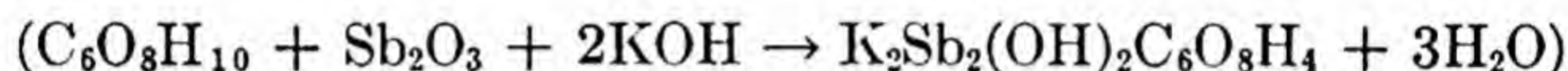
A. Guyard, *Chem. News*, **9**, 13 (1864)

101



I-960

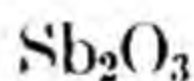
A complex (emetic) is formed in the neutralization of a solution of antimony trioxide in saccharic acid:



Pariselle and Chirvani, *C.R.*, **199**, 203 (1934)

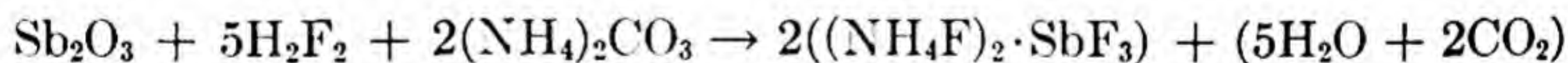
Ref., J. L. Delsal, *J. Chim. phys.*, **35**, 350 (1938)

69



I-961

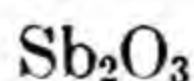
Large rhombic crystals of ammonium fluoantimonate are formed when antimony trioxide is dissolved in hydrofluoric acid, and the solution saturated with ammonium carbonate.



Flückiger, *Pogg. Ann.*, **87**, 245

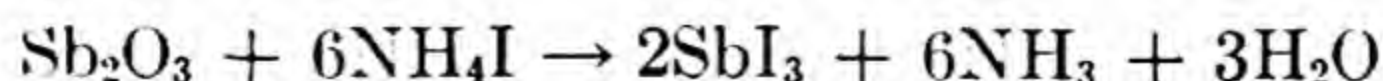
Ref., *Ann.*, **84**, 253 (1852)

1



I-962

Antimony trioxide on ignition at 400°C. reacts with ammonium iodide forming volatile products as follows.

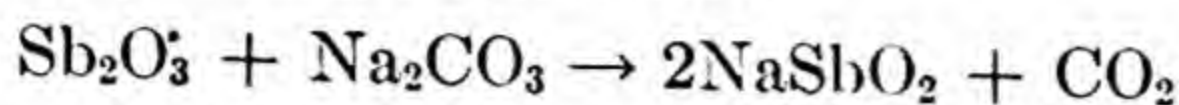


Earle R. Caley and M. Gilbert Barford, *Ind. Eng. Chem., Anal. Ed.*, **8**, 114 (1936)

44

Na₂CO₃**Sb₂O₃****I-963**

Antimony trioxide reacts with sodium carbonate evolving carbon dioxide and forming sodium antimonite.

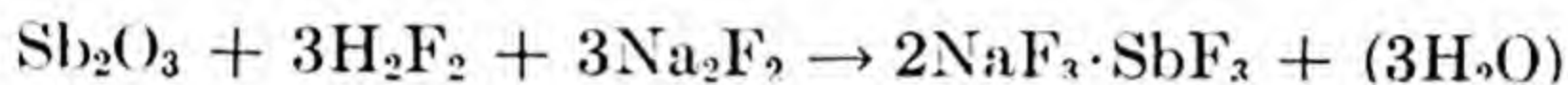


G. F. Bergh, Sv. Farm. Tidskr., **8**, 183 (1904)

10

Na₂F₂**Sb₂O₃****I-964****+H₂F₂**

Small transparent crystals of sodium fluoantimonate are formed when an equivalent amount of antimony trioxide is dissolved in an excess of hydrofluoric acid and then a solution containing three equivalents of sodium fluoride is added.



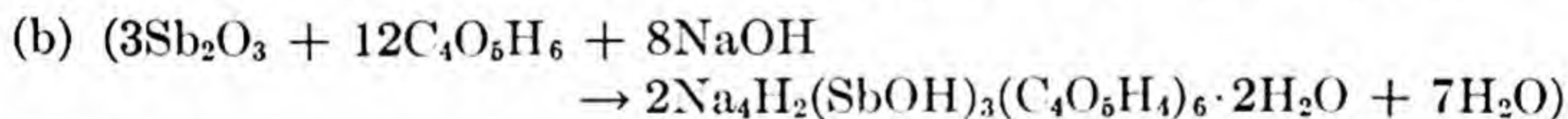
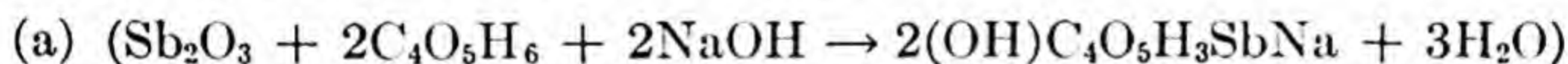
Flückiger, Pogg. Ann., **87**, 245

Ref., Ann., **84**, 252 (1852)

1

NaOH**Sb₂O₃****I-965****C₄O₅H₆**

In the neutralization of a solution of antimony trioxide in malic acid, a complex is formed, which is stable only in an excess of acid, (a). Attempts to crystallize it yield a double salt, (b).

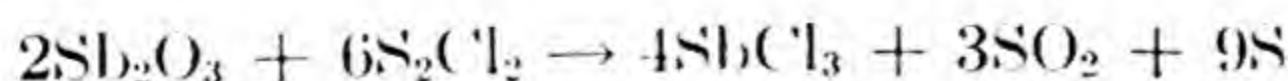


J. L. Delsal, J. Chim. phys., **35**, 350 (1938)

69

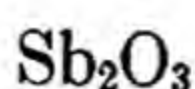
S₂Cl₂**Sb₂O₃****I-966**

6 grams of antimony trioxide and 8.2 grams of sulfur monochloride were heated together in a sealed tube for three hours at 120°C. The tube was cooled and chilled without opening. Only enough water was added to the reaction mixture to allow removal to a distilling flask. The mixture was distilled and antimony trichloride solidified in the receiver.



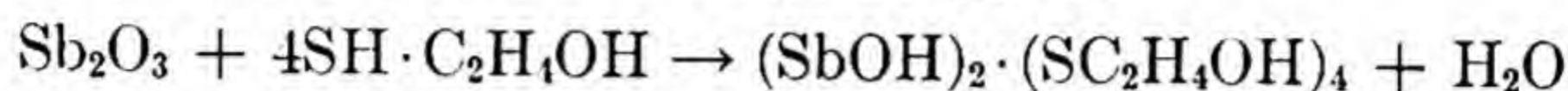
H. Prinz, Ann., **223**, 355 (1884)

20



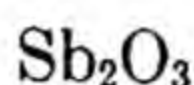
I-967

Colorless crystals of the antimonous mercaptide shown below are obtained by warming monothio-ethylene glycol with antimonous oxide, diluting the solution with alcohol and allowing to crystallize. The product is soluble in monothioethylene glycol.



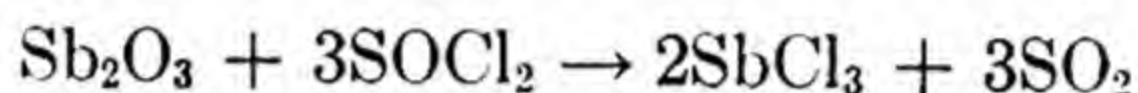
George M. Bennett, J. Chem. Soc. (London), **121**, 2143 (1922)

48



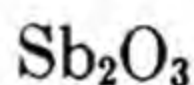
I-968

Antimony trichloride forms when thionyl chloride reacts with antimony trioxide at ordinary temperature.



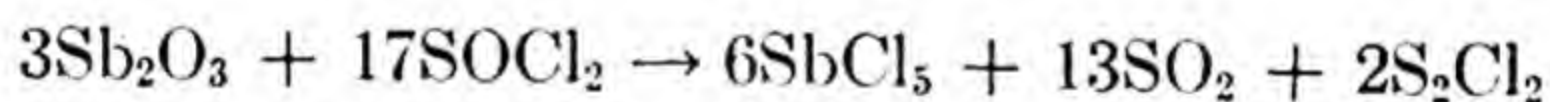
North and Hageman, J. Am. Chem. Soc., **35**, 354 (1913)

1



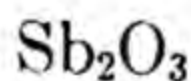
I-969

Antimony pentachloride is obtained when antimony trioxide is heated at 150° for several hours with an excess of thionyl chloride in a sealed tube.



North and Hageman: J. Am. Chem. Soc., **35**, 355 (1913)

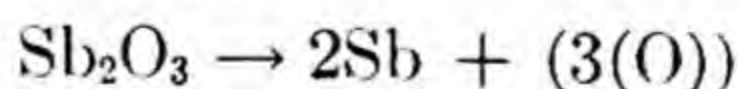
1



e

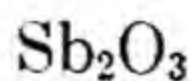
I-970

Antimony trioxide dissolved in sodium pyrophosphate and electrolyzed produced antimony, which did not show any heat evolution.



G. Gore, Trans. Roy. Soc. (London), **148**, 191 (1859)

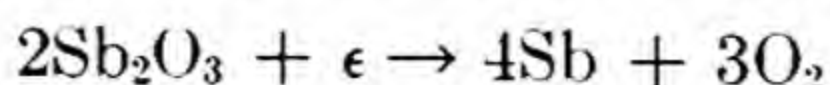
105



e

I-971

A solution of antimony trioxide is brought into solution in a mixture of a saturated sodium hyposulfite solution and an aqueous potassium cyanide solution. Antimony deposits at the cathode.

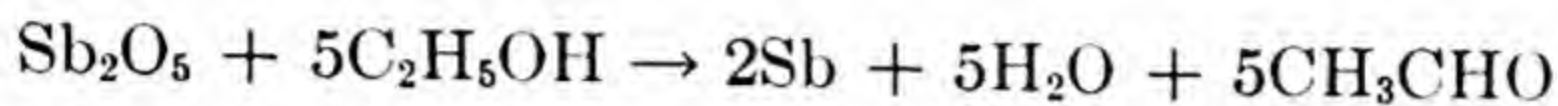


A. Hollard, Ann. Chim. Anal., **8**, 282 (1903)

76

C₂H₅OH**Sb₂O₅****I-972**

Antimony pentoxide is slowly reduced to the metal by the action of ethyl alcohol vapors at 360°, with formation of water and acetaldehyde. The semi-metallic powder produced has no appreciable catalytic action at this temperature.

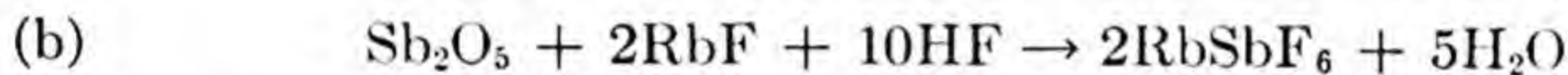


P. Sabatier and A. Mailhe, *Compt. rend.*, **147**, 16 (1908)

38

Sb₂O₅**HF****I-973****NH₄F****RbF**

A solution of antimony pentoxide and ammonium fluoride in 40% hydrofluoric acid is evaporated on the water bath. Crystals of ammonium fluoantimonate are obtained. The same type reaction occurs with rubidium fluoride.

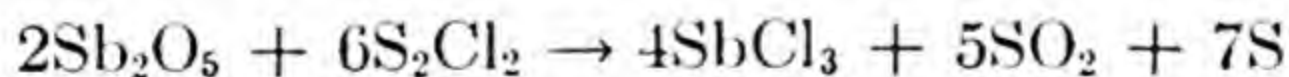


W. Lange and K. Askitopoulos, *Z. anorg. Chem.*, **223**, 369 (1935)

28

Sb₂O₅**S₂Cl₂****I-974**

2 grams of antimony pentoxide and 4 grams of sulfur monochloride are mixed in a tube and sealed. The tube is heated at 100°C. until a homogeneous mixture is obtained. The tube is cooled. The contents are then transferred to a distilling flask and distilled. Crystals of antimony trichloride solidify in the receiver.

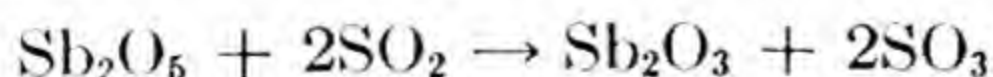


H. Prinz, *Ann.*, **223**, 358 (1884)

20

Sb₂O₅**SO₂****I-975**

Antimony pentoxide is reduced by sulfur dioxide.



L. W. McCay, *J. Am. Chem. Soc.*, **50**, 370 (1928)

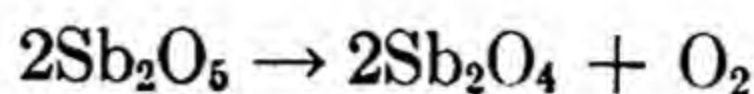
1



Δ

I-976

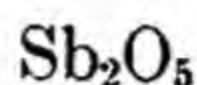
An intermediate oxide of antimony is formed when antimony pentoxide is heated at 300°C.



Geuther, J. prakt. Chem., **4**, 438 (1870)

Ref., Ann., **186**, 111 (1877)

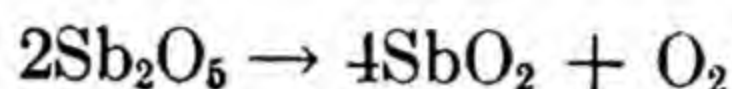
1



Δ

I-977

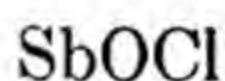
Antimony dioxide is formed when antimony pentoxide is heated to a bright redness.



Szilágyi, Z. anal. Chem., **57**, 23 (1918)

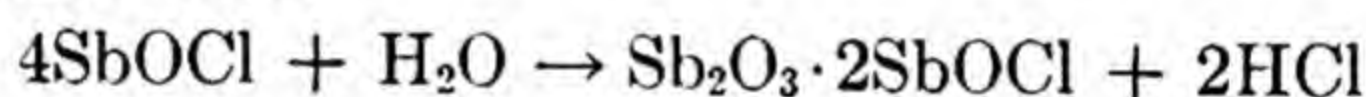
Ref., J. Chem. Soc. (London), **114**, 135 (1918)

1

H₂O

I-978

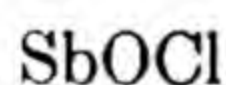
Boiling water hydrolyzes antimony oxychloride to form a complex salt and hydrochloric acid.



Sabanejeff,

Ref., Von Richter, Ber., **4**, 409 (1871)

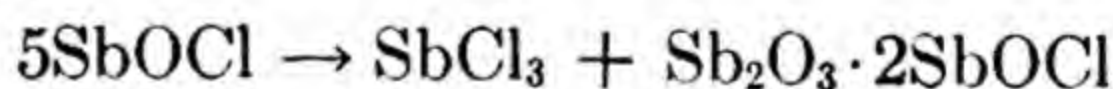
11



Δ

I-979

Heating antimonyl chloride in a closed tube forms antimony trichloride and suboxychloride.



Sabanejeff,

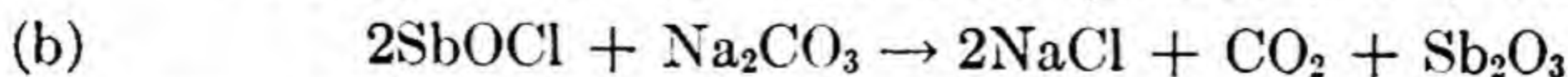
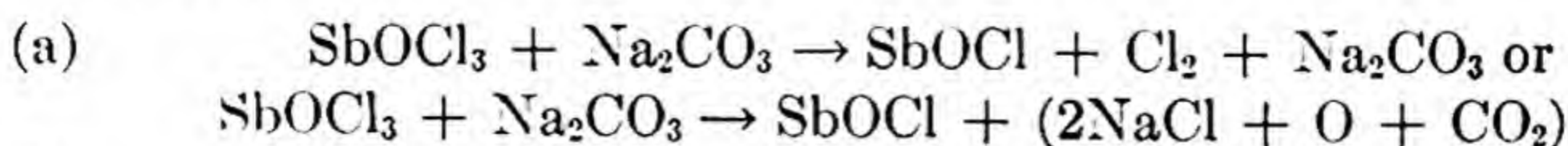
Ref., Von Richter, Ber., **4**, 409 (1871)

11

Na₂CO₃

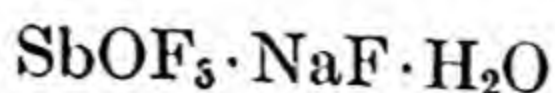
I-980

Antimony trioxide is formed when antimony oxychloride is decomposed with sodium carbonate.

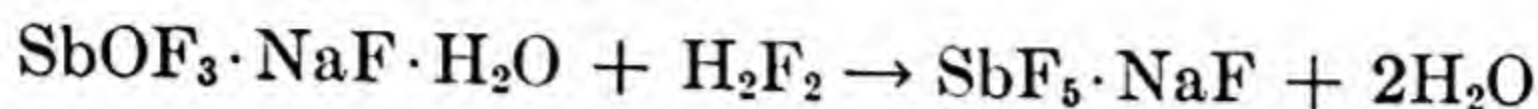


Daubrawa, Ann., **186**, 122 (1877)

1

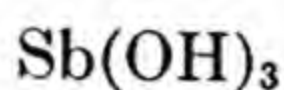
**H₂F₂****I-981**

Cubical crystals separate when antimony oxyfluoride-sodium fluoride is dissolved in hydrofluoric acid.

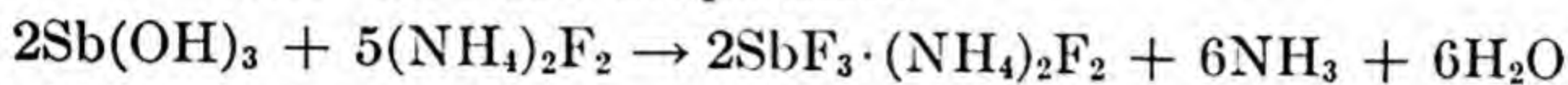


Marignac, *Ann.*, **145**, 245 (1868)

1

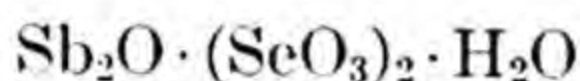
**(NH₄)₂F₂****I-982**

Antimony hydroxide will react with a boiling solution of ammonium fluoride yielding colorless crystals of antimony ammonium fluoride after the excess water has been evaporated.

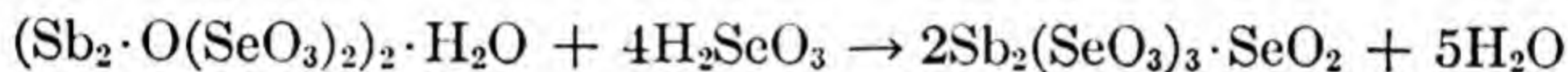


H. V. Helmholt, *Z. anorg. Chem.*, **3**, 115 (1893)

28

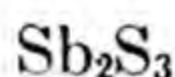
**H₂SeO₃****I-983**

When the hydrated basic antimony selenite is digested with selenious acid at 60° prismatic crystals of antimony selenite selenium dioxide and water are formed.

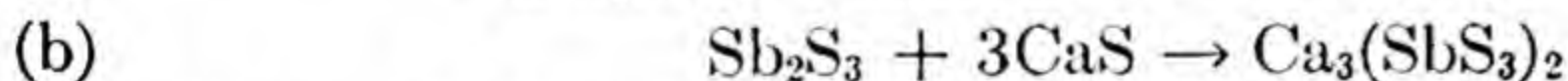
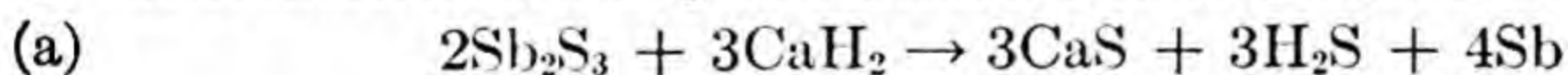


L. F. Nilson, *Nova Acta Reg. Soc. Sci. Upsal.* [3], Vol. **9**, No. 7, 112 (1874)

10

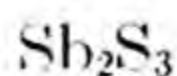
**CaH₂****I-984**

A stoichiometric mixture of antimony trisulfide and calcium hydride is readily ignited and partial reduction to the metal proceeds smoothly with extraordinary swelling. The small yield of metal is accounted for by the formation of complex calcium antimony sulfide compounds.

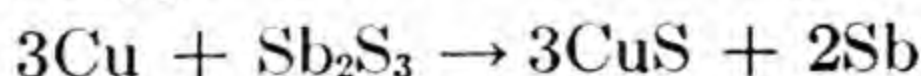


F. W. Perkin and L. Pratt, *Trans. Far. Soc.*, **3**, 183 (1907)

85

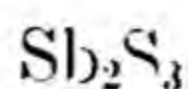
**Cu****I-985**

Antimony trisulfide reacts with copper at elevated temperatures to produce the sulfide of copper and free antimony.

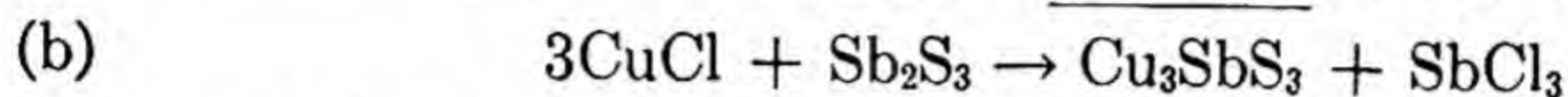
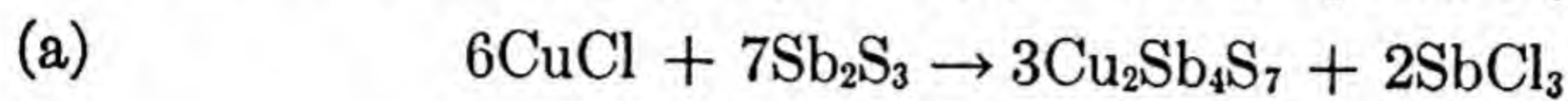


G. Marchal, *Bull. Soc. Chim.* [IV], **33**, 599 (1923)

31

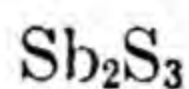
**CuCl****I-986**

By heating a mixture of cuprous chloride and antimony trisulfide to a temperature of 300°, gray crystals (a) or a black powder (b) is obtained.

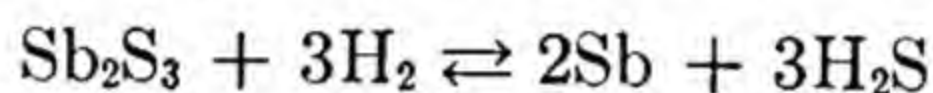


H. Sommerlad, *Z. anorg. Chem.*, **18**, 420 (1898)

28

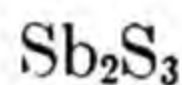
**H****I-987**

When antimony sulfide is reduced by hydrogen at 600°C in a sealed tube the gas phase contains, at equilibrium, both hydrogen and hydrogen sulfide and the solid phase is a solution of antimony in the sulfide.

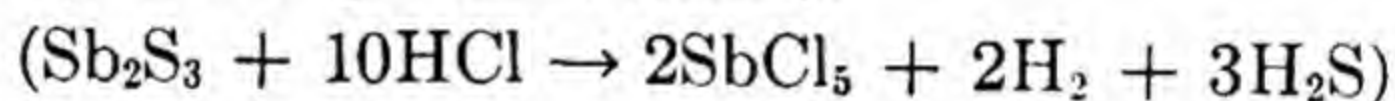


H. Pélabon, *J. Chim. phys.*, **2**, 321 (1904)

69

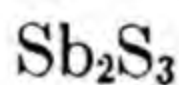
**HCl****I-988**

Antimony trisulfide or trioxide reacts directly with the chlorine in hydrochloric acid to produce antimony pentachloride. (Thus it may be used as a catalyst in organic reactions).

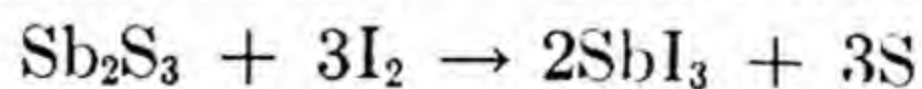


C. Hardy, *Chem. Ind.*, **38**, 364 (1936)

84

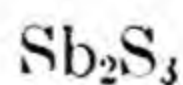
**I₂****I-989**

Antimony trisulfide, when treated with 0.1*N* iodine solution, 30–50 cc of concentrated HCl, and with about 2 g. of tartaric acid, is changed to the triiodide when heated almost to boiling temperatures.

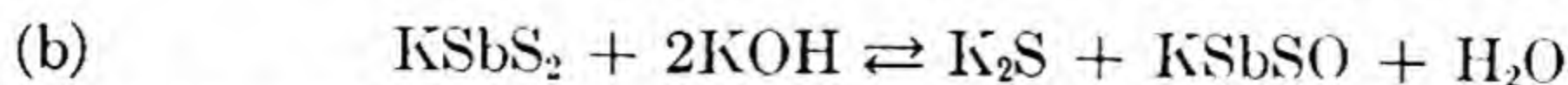
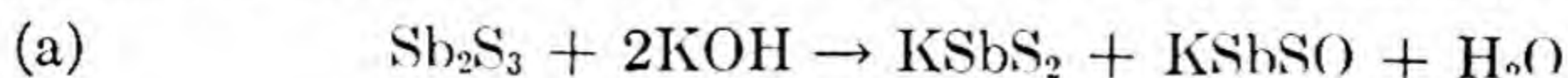


Beneker, *J. Ind. Eng. Chem.*, **3**, 637 (1911)

89

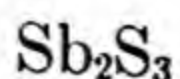
**KOH****I-990**

Antimony trisulfide dissolves in an excess of potassium hydroxide.



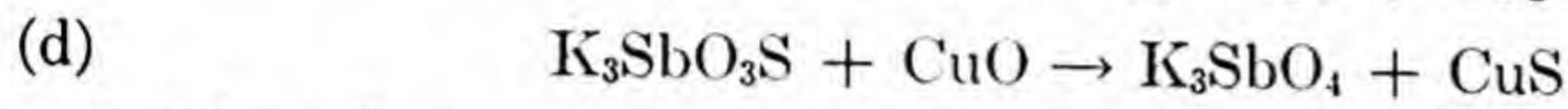
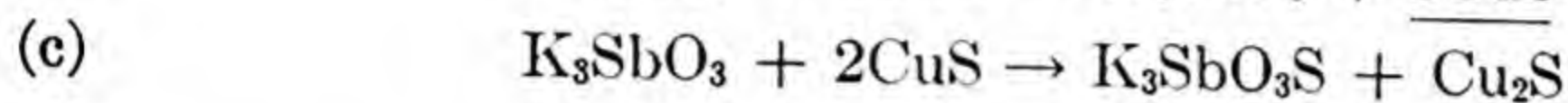
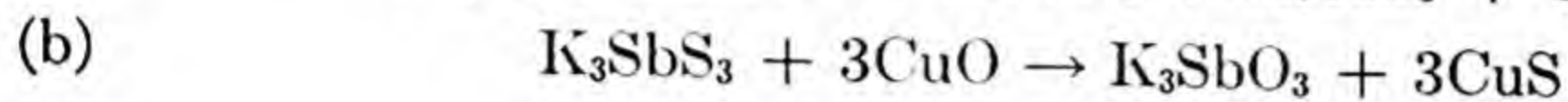
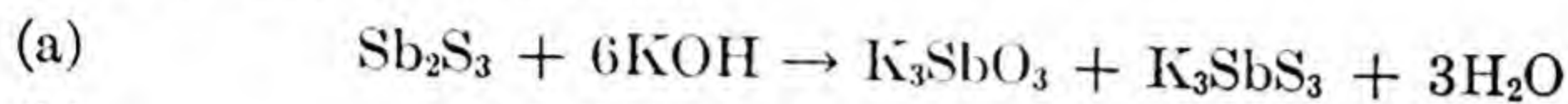
Curtman and Marcus, *J. Am. Chem. Soc.*, **36**, 1097 (1914)

1

KOH
CuO

I-991

A suspension of antimony trisulfide in potassium hydroxide solution is heated with cupric oxide for 30 minutes. By filtering off from the cupric sulfide formed, the potassium antimonate in the filtrate can be precipitated with alcohol.



S. A. Schon, *Z. anorg. Chem.*, **133**, 404 (1924)

28

K₂S

I-992

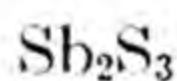
The compound $\text{K}_4\text{Sb}_2\text{S}_5$ separates when a solution containing one equivalent of antimony trisulfide and two of potassium sulfide is allowed to evaporate in a vacuum in the cold.



Poubet, *Compt. rend.*, **124**, 1445 (1897)

Ref., *J. Chem. Soc. (London)*, **72**, 499 (1897)

1

K₂S

I-993

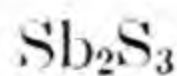
Potassium metathioantimonite is formed when a solution containing one equivalent of antimony trisulfide and two of potassium sulfide is heated out of contact with air.



Pouget, *Compt. rend.*, **124**, 1445 (1897)

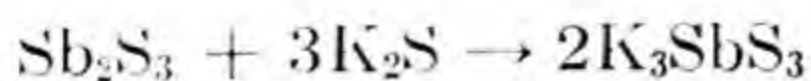
Ref., *J. Chem. Soc. (London)*, **72**, 499 (1897)

1

K₂S

I-994

Normal potassium thioantimonite is obtained as small white very deliquescent crystals when antimony trisulfide, dissolved in a concentrated solution of potassium sulfide, is rapidly concentrated out of contact with air.



Pouget, *Compt. rend.*, **124**, 1445 (1897)

Ref., *J. Chem. Soc. (London)*, **72**, 499 (1897)

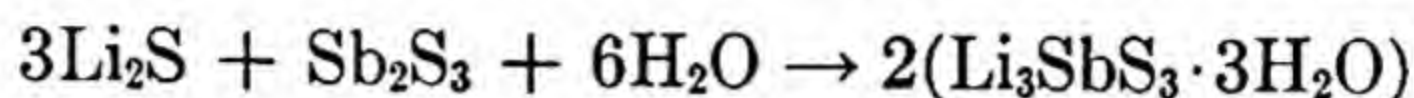
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Li₂S

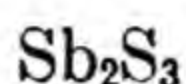
I-995

A solution of one part antimony trisulfide to three parts lithium sulfide on concentration gives crystals of lithium orthothioantimonite.



I. Pouget, *Ann. Chim. Phys.*, **18**, 530 (1899)

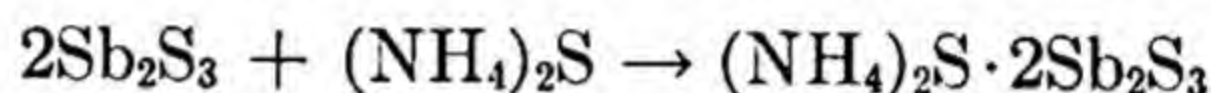
2



(NH₄)₂S

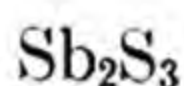
I-996

Red crystals are formed when orange-red antimony trisulfide is heated with colorless ammonium sulfide in a sealed tube to 150°.



VI. von Stanek, *Z. anorg. Chem.*, **17**, 117 (1898)

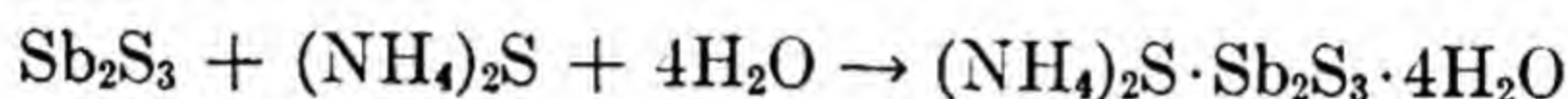
28



(NH₄)₂S

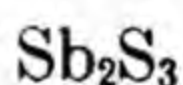
I-997

Yellow crystals are formed when antimony trisulfide reacts with ammonium sulfide.



VI. von Stanek, *Z. anorg. Chem.*, **17**, 117 (1898)

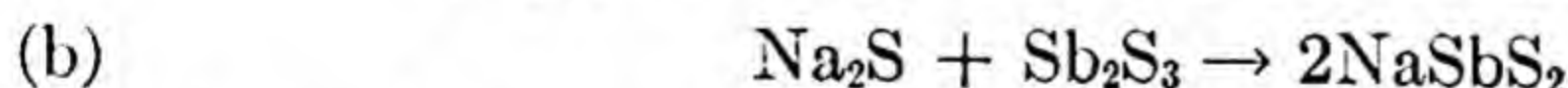
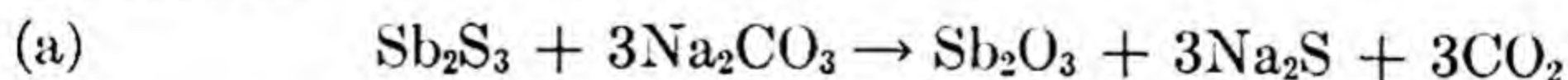
28



Na₂CO₃

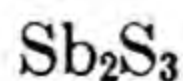
I-998

Antimony trisulfide reacts with sodium carbonate to evolve carbon dioxide and leave antimony trioxide and sodium sulfide. The sodium sulfide unites with some of the antimony trisulfide to form sodium sulfantimonite.



G. F. Bergh, *Sv. Farm. Tidskr.*, **8**, 183 (1904)

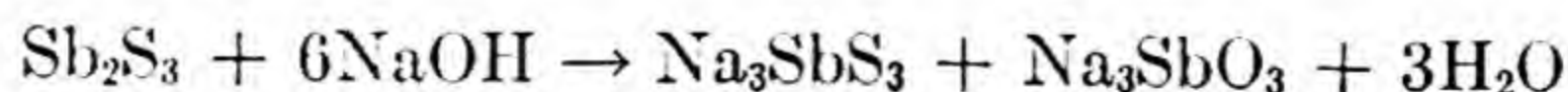
10



NaOH

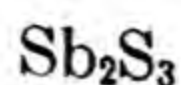
I-999

Stibnite, dissolved in a hot sodium hydroxide solution, yields antimonite and thioantimonite.



Tschernikhov and Uspenskaya, *Ind. Eng. Chem. Anal. Ed.*, **7**, 309 (1935)

33



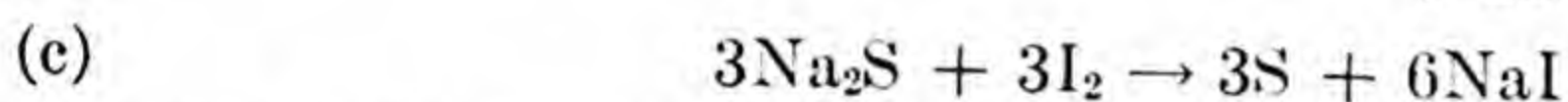
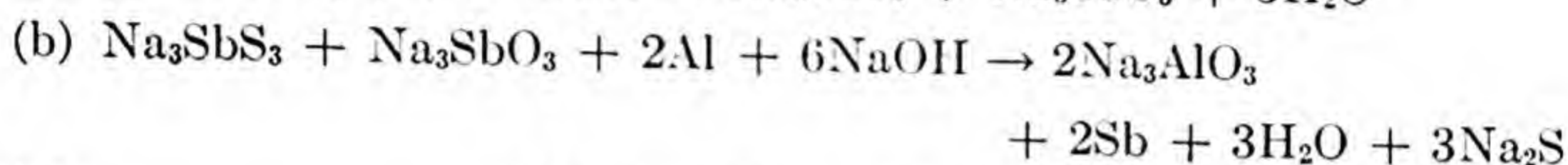
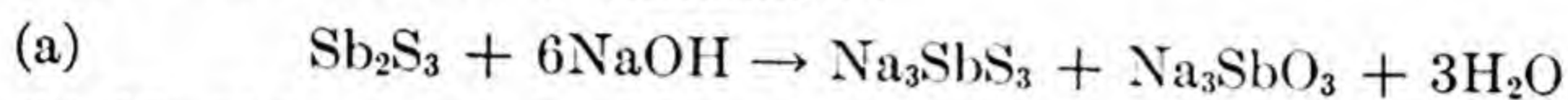
NaOH

I-1000

Al

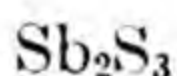
I₂

Stibnite sulfur may be determined as alkali-soluble sulfide. The sample is extracted with hot sodium hydroxide solution, and the resulting solution reduced by aluminum. This precipitates metallic antimony and leaves sulfur in solution as sulfide ion. The sulfide sulfur is determined iodometrically by pouring the solution into a measured excess of standard iodine solution suitably acidified. The excess iodine is titrated with standard thiosulfate.



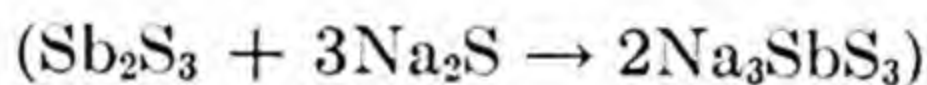
J. A. Tschernikhov and Titiana A. Uspenskaya, *Ind. Eng. Chem., Anal. Ed.*, **7**, 309 (1935)

44

Na₂S

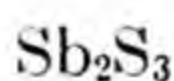
I-1001

Antimony trisulfide is soluble in hot concentrated sodium sulfide solution.



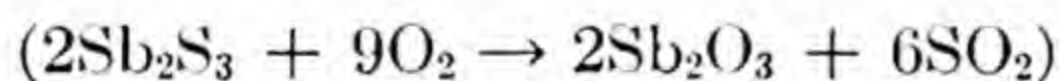
McNabb and Wagner, *Ind. Eng. Chem. Anal. Ed.*, **2**, 254 (1930)

33

O₂

I-1002

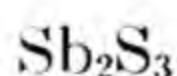
Antimony trisulfide may be transformed into antimony trioxide by heating the sulfide to high temperatures in roasting ovens.



B. Todd, *Chem. News* **8**, 33 (1863)

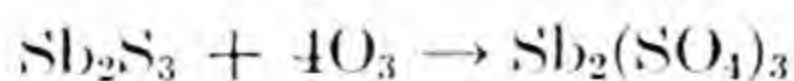
Ref., M. Terreil, *ibid.*, **13**, 82 (1866)

101

O₃

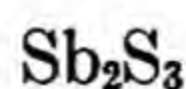
I-1003

Ozone at elevated temperatures transforms stibnite into antimony sulfate.

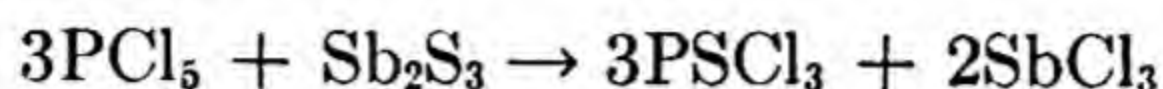


A. Mailfert, *Compt. rend.*, **94**, 1186 (1882)

44

**PCl₅****I-1004**

Phosphorus pentachloride reacts with antimony trisulfide to form phosphorus chlorosulfide.

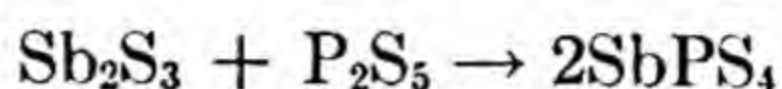


E. Baudrimont, *Compt. Rend.*, **55**, 423 (1862)

29

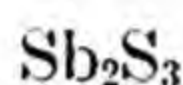
**P₂S₅****I-1005**

Antimonous thiophosphate is obtained when a mixture of antimony trisulfide and phosphorus pentasulfide is heated.

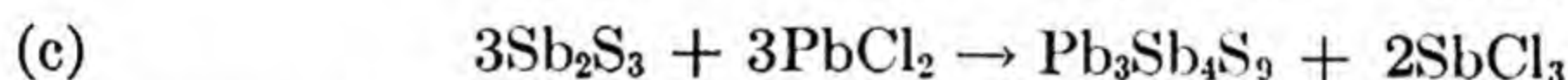
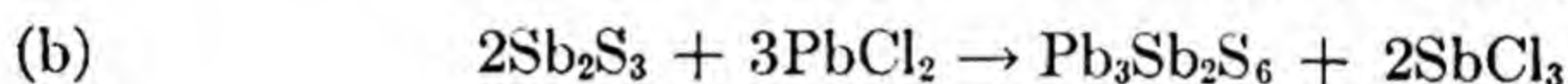
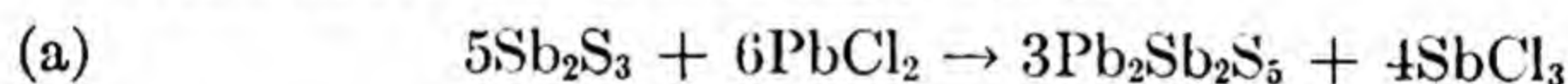


E. Glatzel, *Z. anorg. Chem.*, **4**, 186 (1893)

28

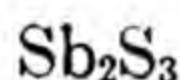
**PbCl₂****I-1006**

Gray colored substances are obtained when antimonous sulfide reacts with lead chloride at a high temperature.

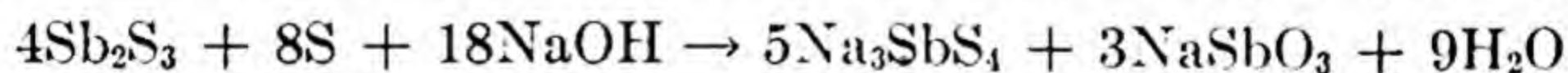


H. Sommerlad, *Z. anorg. Chem.*, **18**, 420 (1898)

28

**S + NaOH****I-1007**

Sodium thioantimonate is formed when a mixture of antimony trisulfide and sulfur is added to a boiling solution of sodium hydroxide.

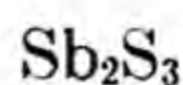


Sartorius, *Apoth. Z.*, **23**, 342 (1908)

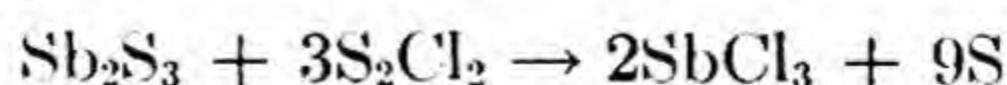
Ref., *Chem. Zentr. I*, 2130 (1908)

Ref., *J. Chem. Soc. (London)*, **94**, 859 (1908)

1

**S₂Cl₂****I-1008**

Stibnite is dissolved immediately by sulfur monochloride with the evolution of much heat.



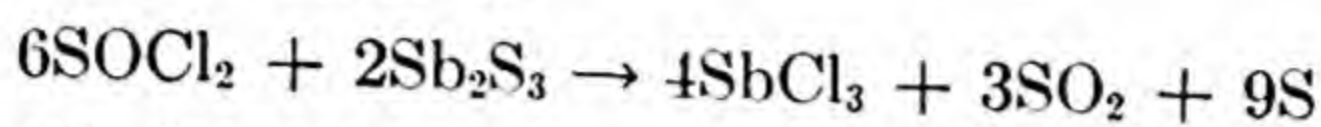
E. F. Smith, *J. Am. Chem. Soc.*, **20**, 291 (1898)

1

SOCl₂Sb₂S₃

I-1009

4.25 grams of antimony trisulfide and 5 grams of thionyl chloride were mixed in a glass tube and sealed. The tube was heated, opened, and the reaction mixture then reheated in the open. Antimony trichloride was a product of the reaction.



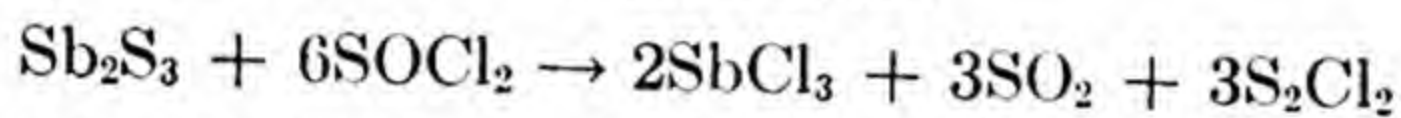
H. Prinz, Ann., **223**, 364 (1884)

20

Sb₂S₃SOCl₂

I-1010

Antimony trichloride results when antimony trisulfide reacts with thionyl chloride at 150–200° in a sealed tube.



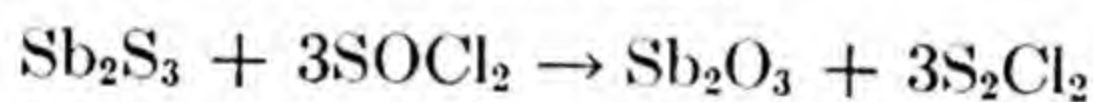
North and Conover, J. Am. Chem. Soc., **37**, 2488 (1915)

1

Sb₂S₃SOCl₂

I-1011

Antimony trisulfide is decomposed by thionyl chloride to yield antimony trioxide and sulfur monochloride.



Hugo Prinz, Ann., **223**, 355 (1884)

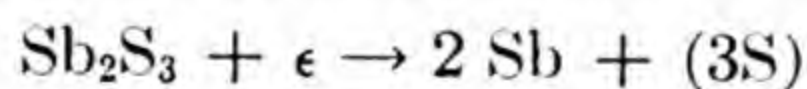
25

Sb₂S₃

e

I-1012

When antimony trisulfide, dissolved in potassium hydroxide, is electrolyzed antimony is deposited without evolution of heat.



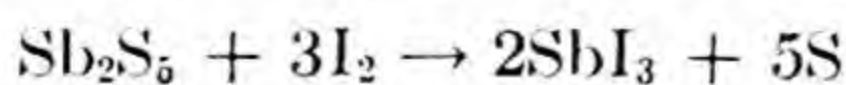
G. Gore, Trans. Roy. Soc. (London), **148**, 191 (1859)

105

Sb₂S₅I₂

I-1013

Antimony pentasulfide upon being treated with an excess of 0.1N solution of iodine, 30–50 cc of concentrated HCl, 2 g. of tartaric acid, is changed to the triiodide by heating to almost the boiling point.

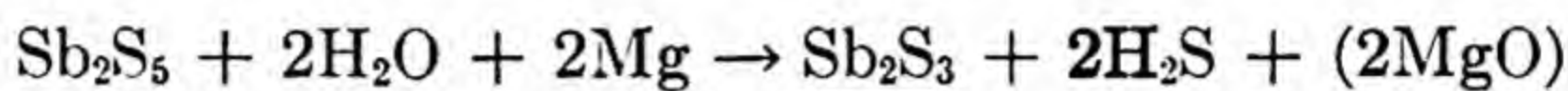


Beneker, J. Ind. Eng. Chem., **3**, 637 (1911)

22

**Mg****I-1014**

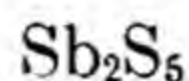
When antimony pentasulfide is suspended in water and mixed with five times its weight of magnesium powder, it is reduced to antimony trisulfide and hydrogen sulfide is evolved.



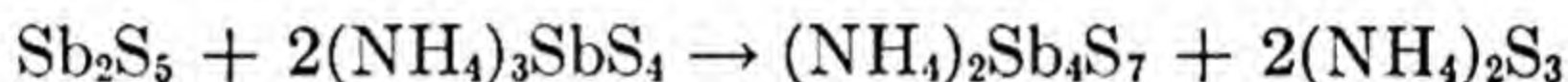
Pertusi, Ann. Chim. Anal., **20**, 229 (1915)

Ref., J. Chem. Soc. (London), **110**, 53 (1916)

1

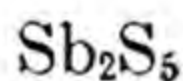
**(NH₄)₃SbS₄****I-1015**

On heating antimony pentasulfide with a solution of ammonium thioantimonate at a temperature of 150° in a sealed tube red crystals are obtained.

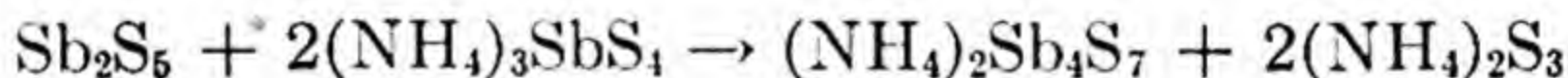


Vl. von Stanek, Z. anorg. Chem., **17**, 117 (1898)

28

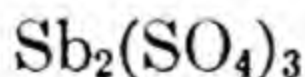
**(NH₄)₃SbS₄****I-1016**

Orthoammonium thioantimonate in solution heated in a sealed tube to 150°C. with antimony pentasulfide yields pyroantimonate together with ammonium trisulfide. The tetrahydrated salt (NH₄)₃Sb₄·4H₂O was also prepared.



Hugo Schiff, Ann., **163**, 209 (1872)

25

**Ag₂SO₄****I-1017**

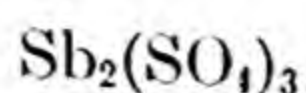
Colorless, cubic, doubly refracting crystals are obtained when a solution of antimony sulfate is treated with a strong sulfuric acid solution of silver sulfate.



Kühl, Z. anorg. Chem., **54**, 256 (1907)

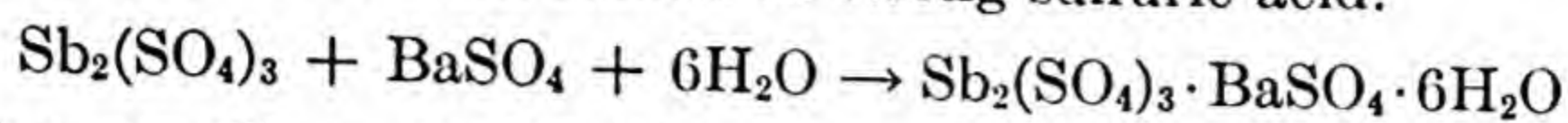
Ref., J. Chem. Soc. (London), **92**, 627 (1907)

1



I-1018

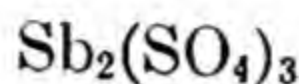
A double compound is formed when antimony sulfate solution is treated with a solution of barium sulfate in strong sulfuric acid.



Kühl, Z. anorg. Chem., **54**, 256 (1907)

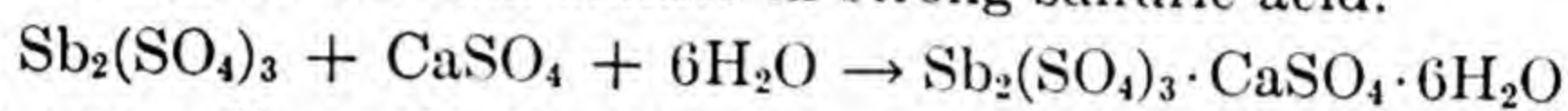
Ref., J. Chem. Soc. (London), **92**, 627 (1907)

1



I-1019

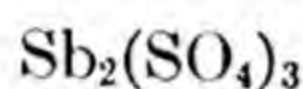
A double salt is formed when a solution of antimony sulfate is treated with a solution of calcium sulfate in strong sulfuric acid.



Kühl, Z. anorg. Chem., **54**, 256 (1907)

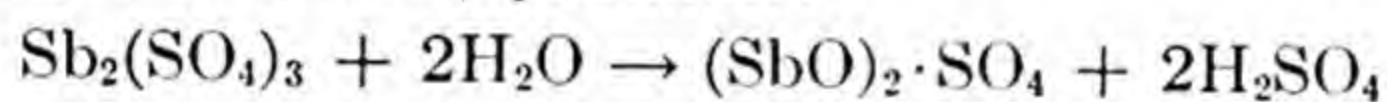
Ref., J. Chem. Soc. (London), **92**, 627 (1907)

1



I-1020

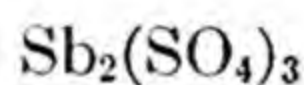
Antimony sulfate decomposes on contact with water, forming in the cold a precipitate of antimonyl sulfate.



S. Metzel, Z. anorg. Chem., **48**, 140 (1906)

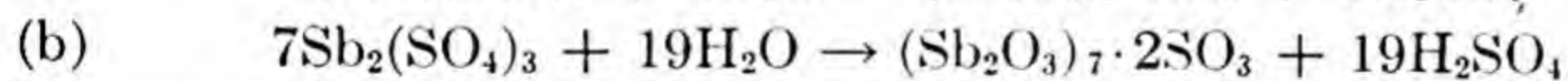
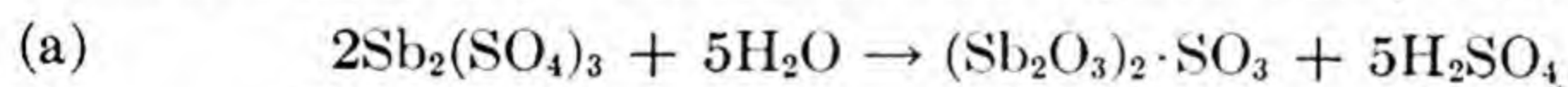
Ref., V. Thomas, Bull. Soc. Chim. (4) **2**, 8 (1907)

31



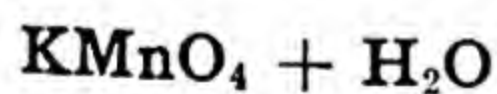
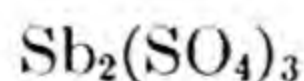
I-1021

Cold water reacts with antimony sulfate to form the compound produced in equation (a), whereas hot water yields that produced in (b).



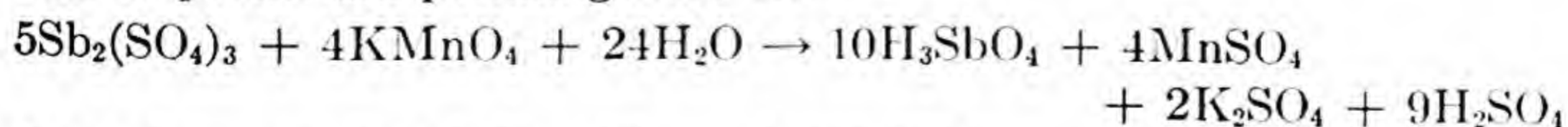
R. H. Addie, J. Chem. Soc. (London), **57**, 540 (1890)

44



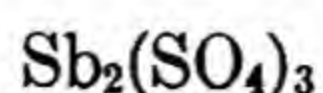
I-1022

The equation for the titration of antimony sulfate with a standard solution of potassium permanganate is:



D. J. Demorest, J. Ind. Eng. Chem., **5**, 842 (1913)

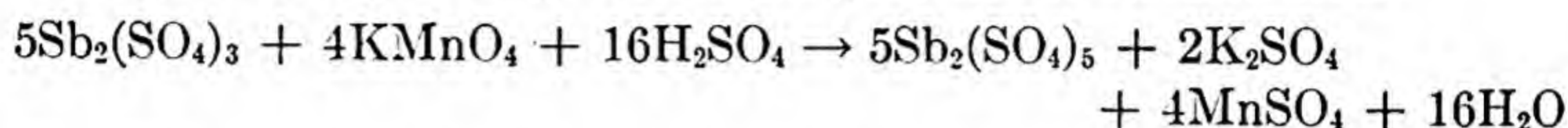
22



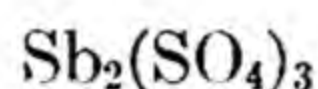
I-1023



A new short method for the accurate determination of antimony in metals, alloys and ores is based on the titration of antimonous sulfate with potassium permanganate in the presence of sulfuric acid.

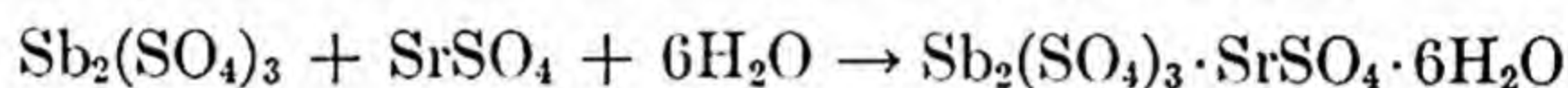


Silve Kallmann and Frank Pristera, *Ind. Eng. Chem., Anal. Ed.*, **13**, 8 (1941) 44



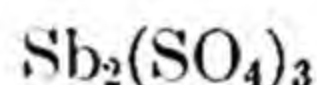
I-1024

A double compound is formed when antimony sulfate solution is treated with a strong sulfuric acid solution of strontium sulfate.



Hugo Kühl, *Z. anorg. Chem.*, **54**, 256 (1907)

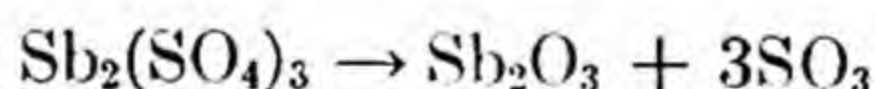
Ref., *J. Chem. Soc. (London)*, **92**, 627 (1907) 1



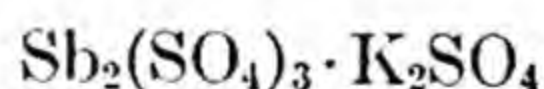
Δ

I-1025

Antimony sulfate on strong heating forms sulfur trioxide and antimony trioxide.

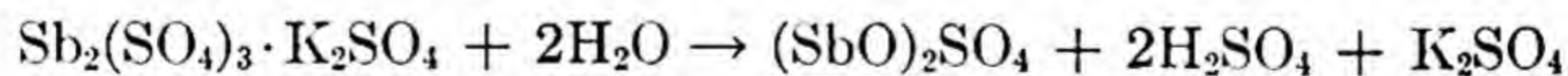


C. Schultz-Sellack, *Ber.*, **4**, 13 (1871) 11

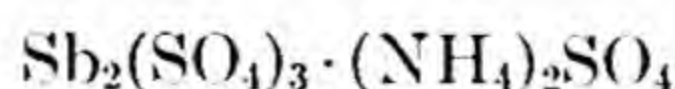


I-1026

Antimony potassium sulfate is decomposed by cold water yielding a precipitate of antimonyl sulfate.

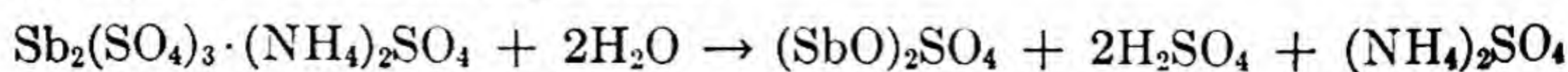


L. Metzl, *Z. anorg. Chem.*, **48**, 140 (1906) 28

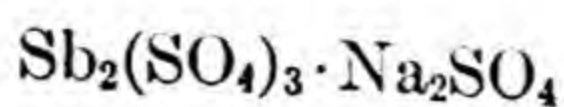


I-1027

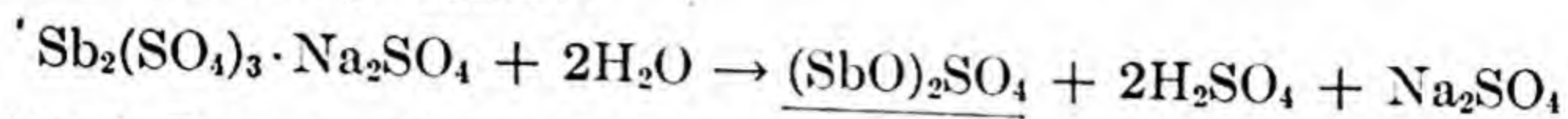
Antimony ammonium sulfate is decomposed by cold water yielding a precipitate of antimonyl sulfate.



L. Metzl, *Z. anorg. Chem.*, **48**, 140 (1906) 28

**H₂O****I-1028**

Antimony sodium sulfate is decomposed by cold water yielding a precipitate of antimonyl sulfate.

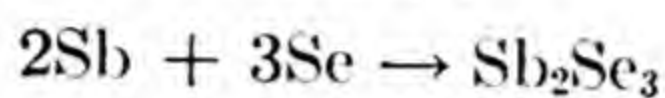


L. Metzl, Z. anorg. Chem., **48**, 140 (1906)

28

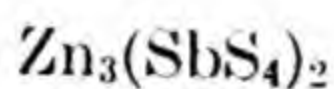
Sb**Se****I-1029**

The elements selenium and antimony in a finely powdered mixture combine at about 450° to form the selenide.

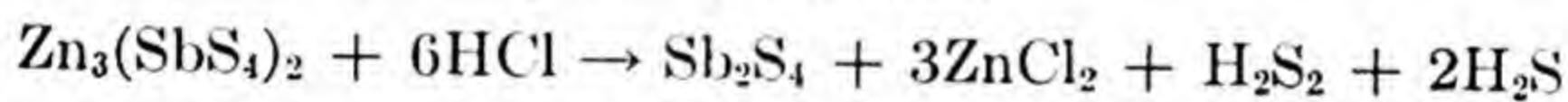


H. Pélabon, J. chim. phys., **2**, 321 (1904)

69

**HCl****I-1030**

Pure antimony tetrasulfide is prepared when zinc thioantimonate is decomposed with dilute hydrochloric acid.



von F. Kirchhoff, Z. anorg. Chem., **112**, 67 (1920)

Ref., J. Chem. Soc. (London), **118**, 693 (1920)

1

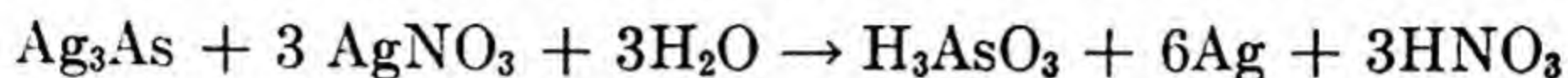
ARSENIC

Ag₃As

AgNO₃

I-1031

Silver arsenide decomposes in presence of nitric acid and silver nitrate.



Hans Reckleben, Georg Lockemann and A. Eckardt, *Z. anal. Chem.* **46**, 671 (1907)
 Ref., *J. Chem. Soc. (London)* **94**, 36 (1908)

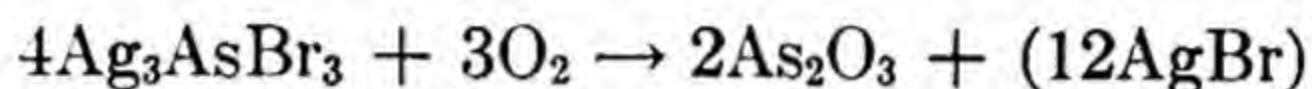
25

Ag₃AsBr₃

O₂

I-1032

Arsenic trioxide is formed when silver tribromoarsenite is heated in air.



Siegfried Hilpert and F. Herrmann, *Ber.*, **46**, 2218 (1913)

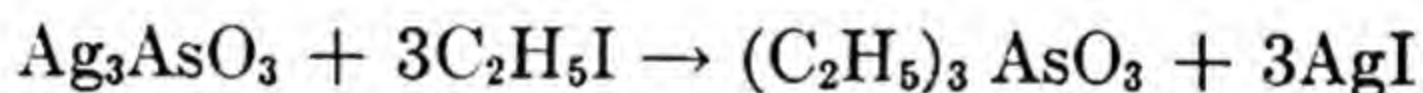
1

Ag₃AsO₃

C₂H₅I

I-1033

Ethyl iodide reacts with silver arsenite to form triethyl arsenite and silver iodide.



Crafts,
 Ref., *Ch. Friedel, Ber.*, **3**, 621 (1870)

11

Ag₃AsO₃

KOH

I-1034

Silver arsenite is soluble in potassium hydroxide, but it decomposes very slowly, precipitating silver as a black powder.



A. Reynoso, *Compt. Rend.*, **31**, 69 (1850)

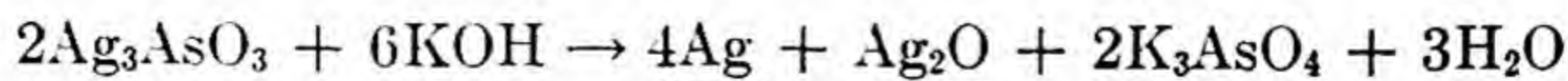
29

Ag₃AsO₃

KOH

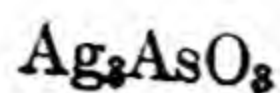
I-1035

Silver oxide precipitates when silver arsenite in solution is treated with potassium hydroxide.



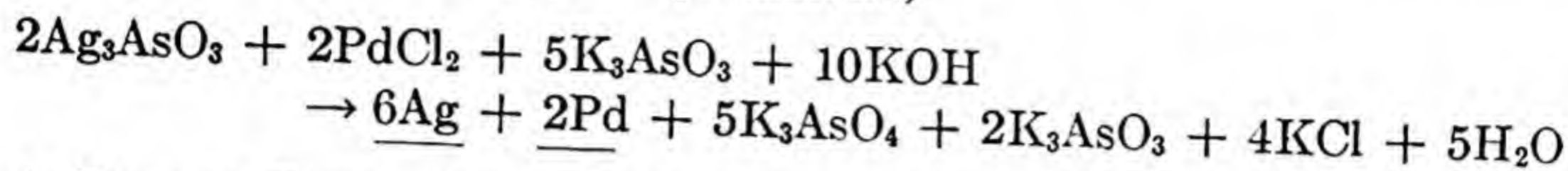
Reichard, *Ber.*, **27**, 1019 (1894)

25



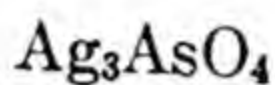
I-1036

Upon adding a solution of palladium chloride containing potassium arsenite to a solution of silver arsenite in KOH, a black precipitate of silver and palladium is formed. (The chloride of platinum is reduced almost as quickly as that of palladium.)



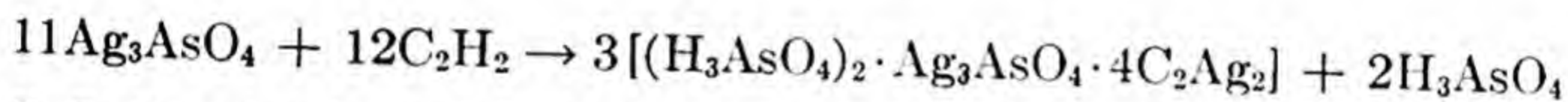
A. Reynoso, *Compt. Rend.*, **31**, 69 (1850)

29



I-1037

Acetylene silver arsenate is prepared when acetylene reacts with a solution of silver arsenate.



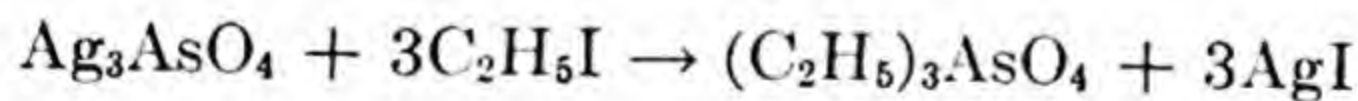
P. B. Oberdoerfer and J. A. Nieuwland, *J. Am. Chem. Soc.*, **44**, 839 (1922)

1



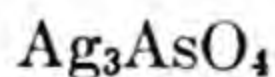
I-1038

Ethyl iodide reacts with silver arsenate in solution to form triethyl arsenate and silver iodide.



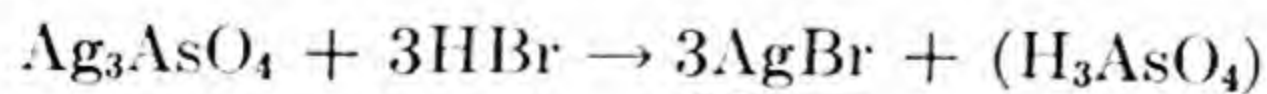
Crafts,
Ref., Ch. Friedel, *Ber.*, **3**, 620 (1870)

11



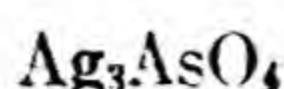
I-1039

A precipitate of yellow silver bromide is formed when hydrogen bromide reacts with silver arsenate in the cold.

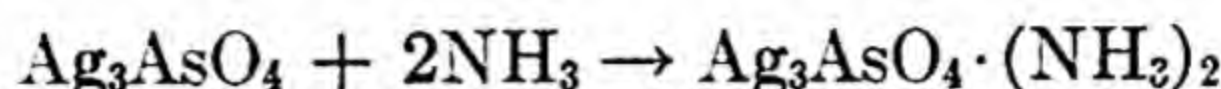


E. A. Atkinson, *J. Am. Chem. Soc.*, **20**, 806 (1898)

1

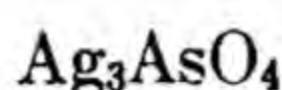
**NH₃****I-1040**

When ammonia gas is passed over silver orthoarsenate that has been dried at 100° silver orthoarsenate diammoniate is left.

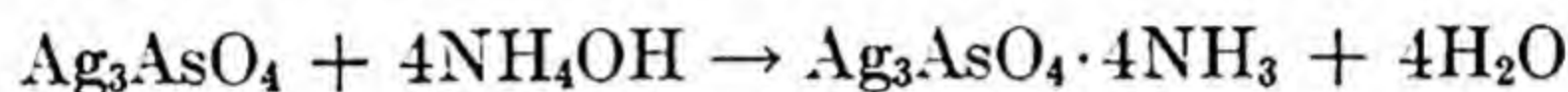


O. Widman, K. Sv. Vet. Ak. Handl. Öfver., **31**, No. 4, 43 (1874)

10

**NH₄OH****I-1041**

When freshly precipitated silver orthoarsenate is dissolved in ammonium hydroxide and allowed to stand, after the addition of alcohol, transparent crystals of silver orthoarsenate tetrammoniate are deposited.

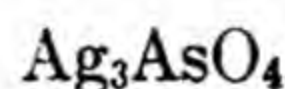


Girard, Compt. Rend., **36**, 793 (1853)

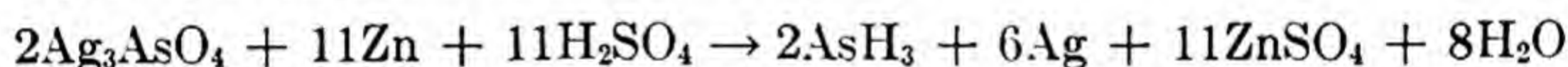
29

Ref., O. Widman., K. Sv. Vet. Akad. Handl. Öfvers, **31**, No. 4, 43 (1874)

10

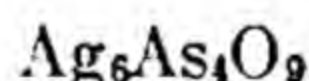
**Zn****I-1042****H₂SO₄**

An algebraic method of balancing a chemical equation uses the following to illustrate the method employed:

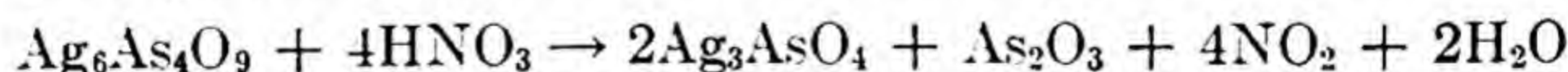


Harry A. Curtis, Science, **56**, 258 (1922)

44

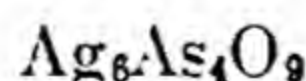
**HNO₃****I-1043**

Silver tetrarsenite is decomposed by nitric acid, giving off nitrogen dioxide, and producing silver arsenate and arsenic trioxide.

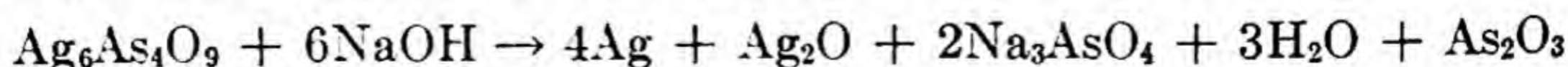


Girard, Compt. Rend., **34**, 920 (1852)

29

**NaOH****I-1044**

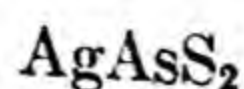
Silver tetrarsenite is decomposed by sodium hydroxide with the formation of metallic silver and silver oxide.



Reichard, Ber., **27**, 1022 (1894)

Ref., Ber., **31**, 2163 (1898)

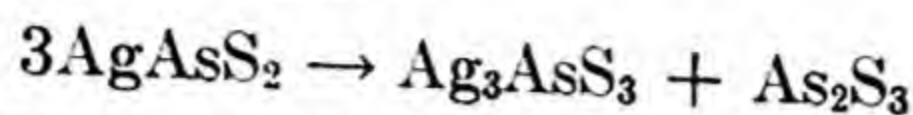
1



Δ

I-1045

Silver metathioarsenite decomposes when heated producing silver orthoarsenite and arsenic trisulfide.



Sommerlad, Z. anorg. Chem., **18**, 420 (1898)

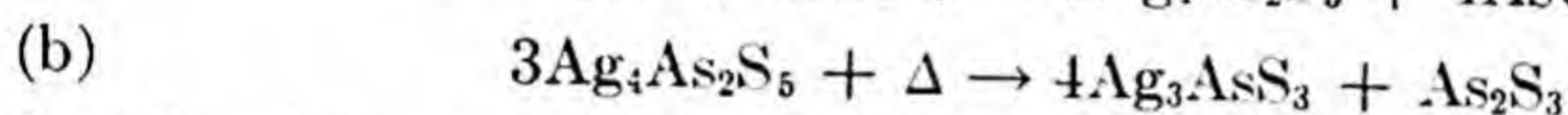
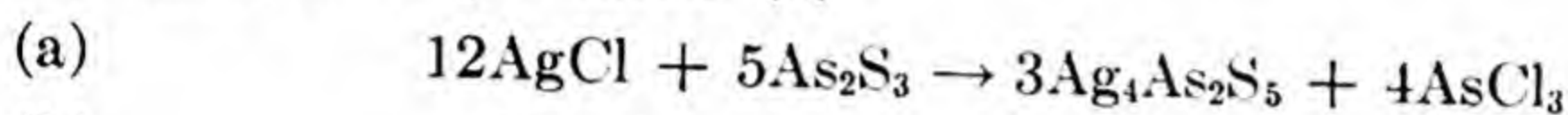
1



Δ

I-1046

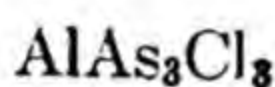
When silver pyroarsenite, obtained by heating silver chloride and arsenic trisulfide without access to air, (a), is similarly heated, silver thioarsenite is produced (b).



Berzelius, Pogg. Ann., **164**, 202

Ref., H. Sommerlad, Z. anorg. Chem., **15**, 177 (1897)

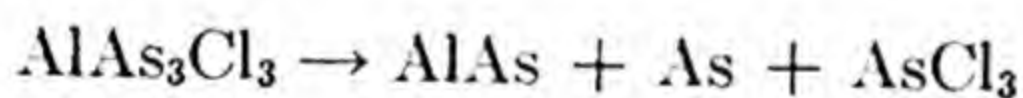
25



Δ

I-1047

Aluminum triarsenic trichloride decomposes upon heating, forming aluminum arsenide.



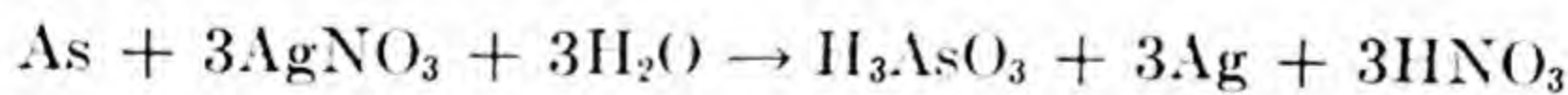
Ruff and Staib, Z. anorg. Chem., **117**, 200 (1921)

25



I-1048

Arsenious acid and silver are formed when arsenic is treated with a neutral solution of silver nitrate.



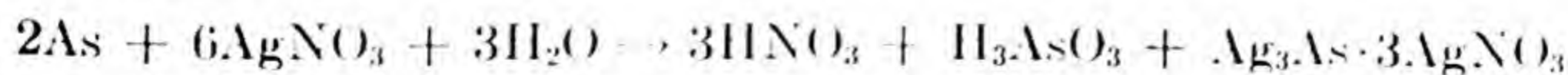
Senderens, Compt. rend., **104**, 175 (1887)

25



I-1049

A double compound is formed when arsenic reacts with a solution of silver nitrate.



T. Poleck and K. Thummel, Ber., **16**, 2435 (1883)

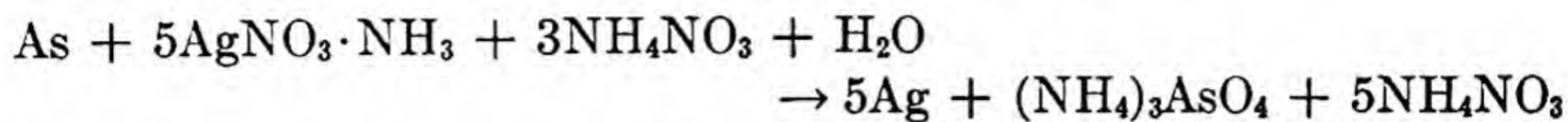
25

As

AgNO₃·NH₃

I-1050

An ammonical solution of silver nitrate is reduced to silver by arsenic when boiled, in the presence of ammonium nitrate.



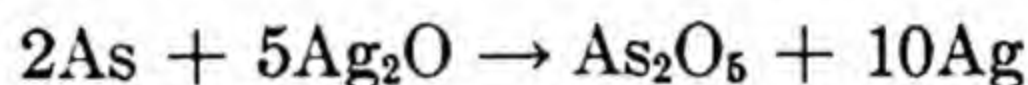
H. Reckleben, G. Lockemann and A. Eckardt, *Z. anal. Chem.*, **46**, 671 (1907) 28
 Ref., W. P. Skertchly, *J. Chem. Soc. (London)*, **94**, 36 (1908) 57

As

Ag₂O

I-1051

An ammoniacal solution of silver oxide is reduced by arsenic.



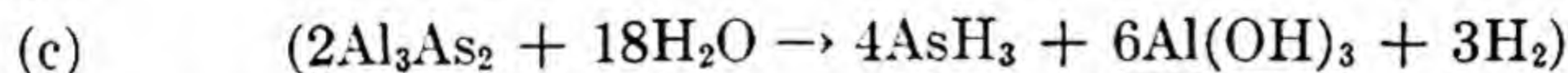
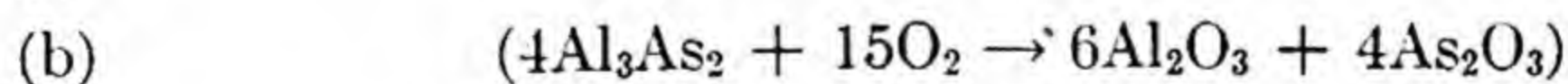
Reckleben, Lockemann and Eckardt, *Z. Anal. Chem.*, **46**, 671 (1907) 25

As

Al

I-1052

At 750° and reduced pressure, yellow arsenic reacts with aluminum to form an amorphous powder resembling iron rust, whose composition is shown in (a). Upon decomposition, this compound yields yellow arsenic. When heated in air, the compound is oxidized to arsenic trioxide and aluminum oxide, (b). The compound is very reactive: arsine is evolved upon exposure to moisture, (c).



Quasim A. Mansuri, *J. Chem. Soc. (London)*, **121**, 2277 (1922) 48

As

Br₂
S

I-1053

Mixing arsenic, sulfur, and bromine and cooling the mixture to -18° produces a red compound melting at -17°. The empirical formula of this compound is given below:



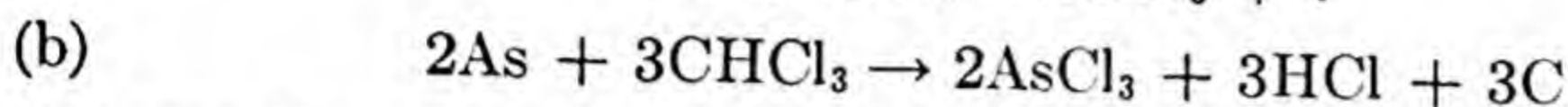
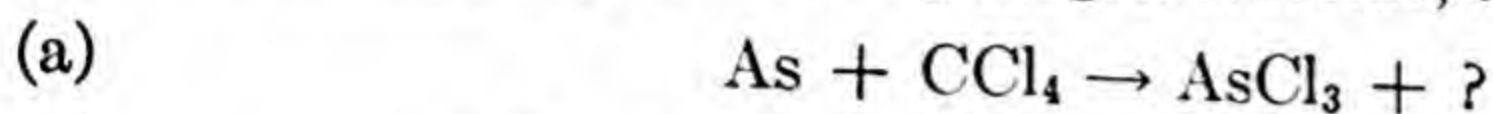
J. B. Hannay, *J. Chem. Soc., (London)*, **33**, 291 (1878) 91

As

CCl₄CHCl₃

I-1054

When amorphous arsenic is heated in a sealed tube at 160° with carbon tetrachloride, arsenic trichloride is formed. With chloroform the products are arsenic trichloride, hydrogen chloride, and amorphous carbon.



V. Auger, *Compt. rend.*, **145**, 808 (1907)

Ref., E. Horton, *J. Chem. Soc. (London)*, **94**, 13 (1908)

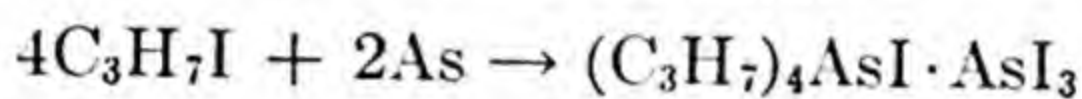
57

As

C₃H₇I

I-1055

Arsenic reacts with propyl iodide and forms the double salt of tetrapropyl arsonium iodide and arsenic triiodide.



A. Cahours,

Ref., A. Henninger, *Ber.*, **6**, 568 (1873)

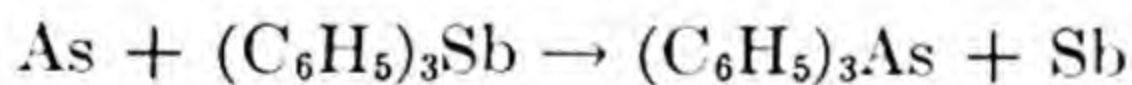
11

As

(C₆H₅)₃Sb

I-1056

Triphenyl arsine is obtained when triphenyl stibine is heated to 350° with finely powdered arsenic for eight hours in a tube.



Krafft and Neumann, *Ber.*, **34**, 565 (1901)

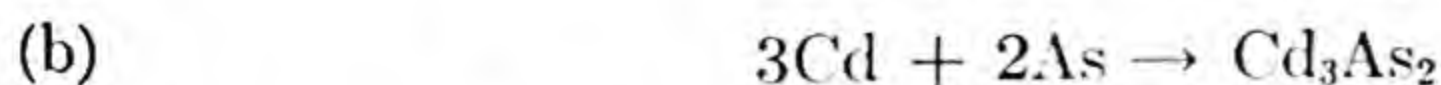
25

As

Cd

I-1057

Mixtures of cadmium and arsenic were melted together under a layer of lithium and potassium chlorides. Two different arsenides were obtained.



Zhemchuzknut, *J. Russ. Phys. Chem. Soc.*, **45**, 1137

28

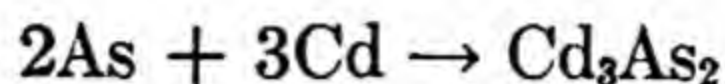
As

Cd

I-1058

P

Cadmium arsenide is formed when a mixture of cadmium and arsenic is subjected to pressure.



W. Spring, Ber., **16**, 324 (1883)

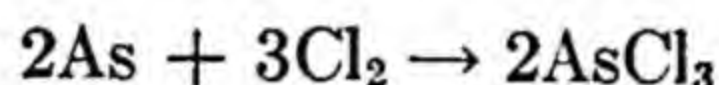
25

As

Cl₂

I-1059

Arsenic burned in chlorine forms arsenic trichloride.



Humphry Davy, Trans. Roy. Soc. (London), **101**, 23 (1811)

Ref., John Davy, Trans. Roy. Soc. (London), **102**, 186 (1912)

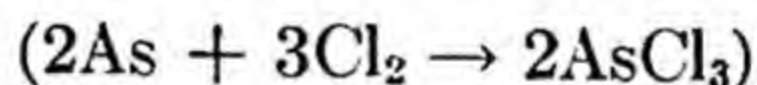
105

As

Cl₂

I-1060

Arsenic trichloride can be prepared by the action of chlorine on metallic arsenic. The compound thus obtained is purified by distillation and the fraction at 134° is collected. The molecular extinction coefficients of this substance range between 5-30, whereas those of antimony trichloride range between 600-3000.



Dumas, Ann. Phys., (I), **9**, 308 (1827)

Ref., Alexander K. Macbeth and Norah I. Maxwell, J. Chem. Soc., **123**, 374 (1923)

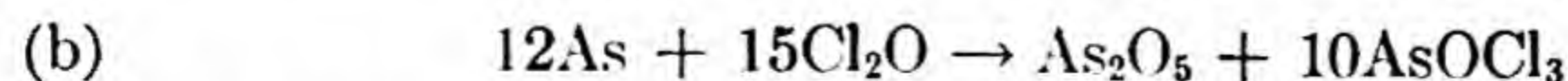
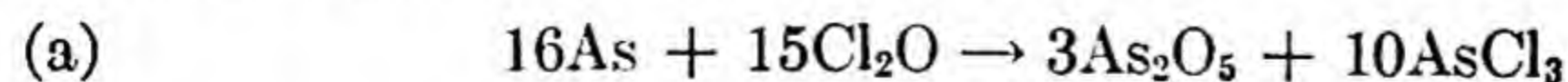
48

As

Cl₂O

I-1061

Arsenic reacts with chlorine monoxide to form arsenic pentoxide and arsenious chloride or arsenic oxychloride.



Schutzenberger,

Ref., Ch. Friedel, Ber., **2**, 219 (1869)

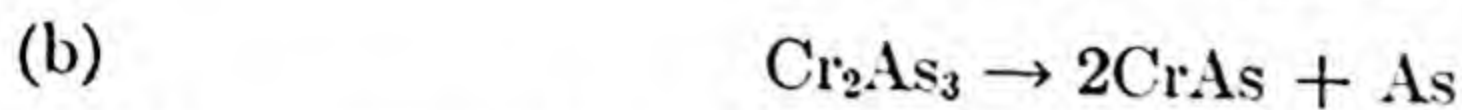
11

As

Cr

I-1062

By heating a mixture of arsenic powder with chromium powder in a closed tube for 30 hours at 700°, chromium arsenide is obtained. When this is distilled in a hydrogen atmosphere at 500° monochromium arsenide is formed.



Th. Dieckmann and O. Hauf, *Z. anorg. Chem.*, **86**, 291 (1914)

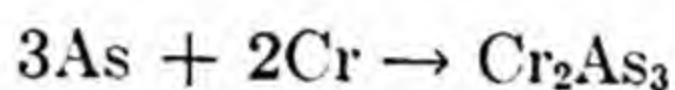
28

As

Cr(amalg)

I-1063

Chromium arsenide is obtained when arsenic and chromium amalgam are heated together in an evacuated tube at 700° for thirty hours.



Th. Dieckmann and Hanf: *Z. anorg. Chem.*, **86**, 293 (1914)

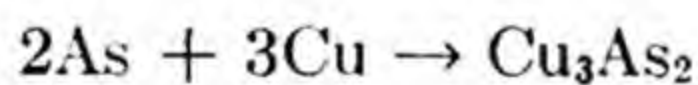
25

As

Cu

I-1064

Cupric arsenide was formed when a mixture of copper and arsenic was subjected to pressure.



W. Spring: *Ber.*, **16**, 324 (1883)

25

As

Fe

I-1065

FeAs is obtained when a mixture of powdered iron and arsenic is distilled at 700°C. in a stream of hydrogen (a).

If the mixture is heated in a closed tube for twelve hours at 700°C., FeAs₂ is obtained (b).



Hilpert and Dieckmann: *Ber.*, **44**, 2378 (1911)

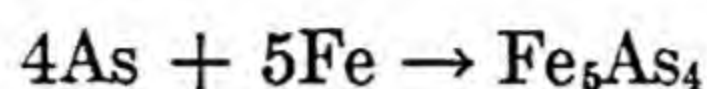
25

As

Fe

I-1066

If arsenic and iron in powdered form, and in the proper proportions, are heated a complex arsenide is obtained.



K. Friederich, *Met.*, **4**, 129 (1907)

Ref., Mellor, A. *Comprehensive Treatise*, **9**, p. 73

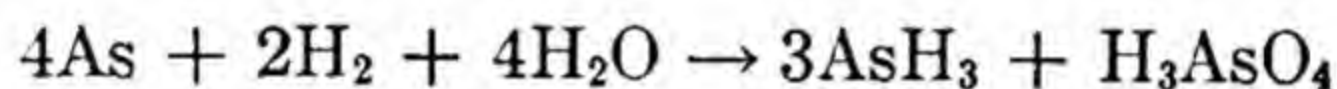
28

As

H₂

I-1067

Arsenic reacts slowly with water at 340° under a hydrogen pressure of 180 atmospheres with the formation of a small amount of arsine and arsenic acid.



I. Patiew: *Ber.*, **59**, 1412 (1926)

25

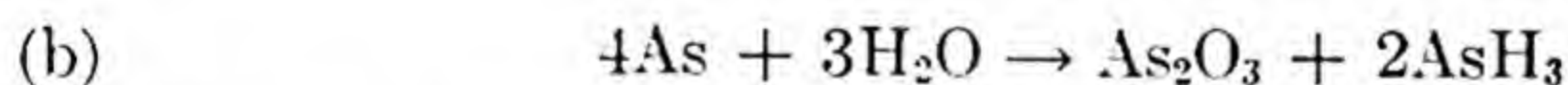
As

H₂

I-1068

H₂O

Arsenic may be reduced to arsine at elevated temperatures by either hydrogen or water.



H. M. Elsey, *Science*, **66**, 300 (1927)

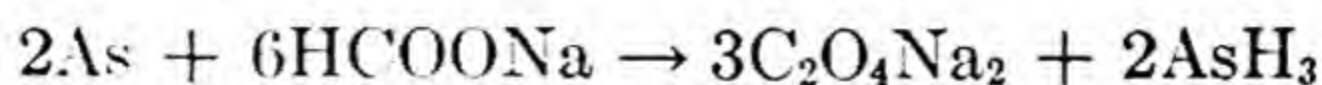
44

As

HCOONa

I-1069

Sodium oxalate is formed together with the evolution of arsine, when a mixture of three parts of powdered arsenic and eight parts of sodium formate is heated to 400°.



Vournasos: *Ber.*, **43**, 2264 (1911)

25

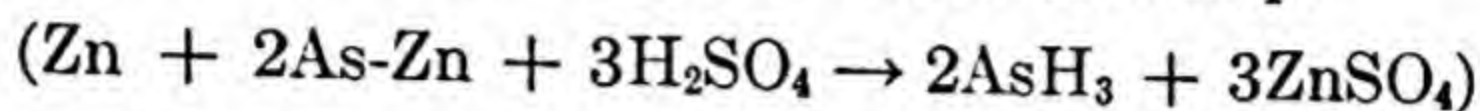
As

 H_2SO_4

Zn

I-1070

An alloy of 53% zinc and 47% arsenic is prepared according to Cohen, [Z. physik. Chem. **25**, 483 (1898)] and warmed with 30% sulfuric acid to give arsine. The gas is dried with calcium chloride and phosphorus pentoxide and condensed in a dry ice-chloroform trap.



R. Robertson and J. J. Fox, Proc. Roy. Soc. (London), **120A**, 160 (1928)

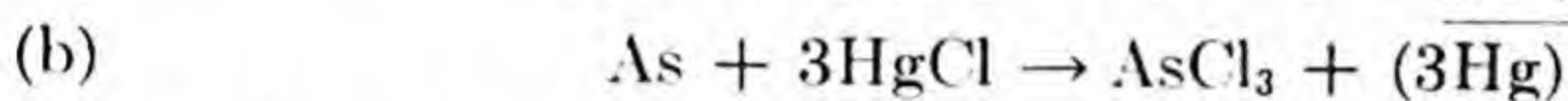
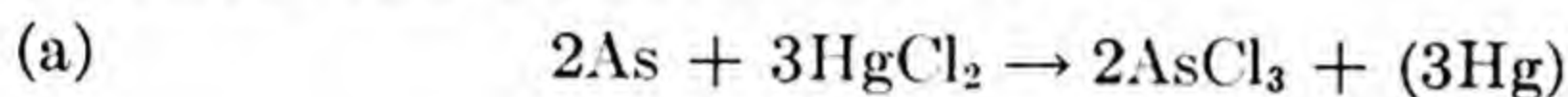
110

As

 HgCl_2 HgCl

I-1071

A mixture of arsenic and mercuric chlorides when heated produces arsenic trichloride and free mercury. The same reaction occurs when mercurous chloride is substituted.



John Davy, Trans. Roy. Soc. (London), **102**, 186 (1812)

105

As

I

I-1072

 NaHCO_3

When arsenic, iodine and sodium bicarbonate are heated together the result is disodium hydrogen arsenate, sodium iodide, carbon dioxide and water.



F. Ageno and N. Guicciardini, Gazz. Chim. Ital. **41**¹, 477 (1911)

21

As

I

I-1073

 NaHCO_3

Elementary arsenic may be quantitatively determined by means of a standard iodine solution (0.01 to 0.1N), in the presence of a slight excess of sodium bicarbonate. The excess iodine is titrated back with standard sodium arsenite.



L. W. Andrews and H. V. Farr, Z. anorg. Chem., **61**, 123 (1909)

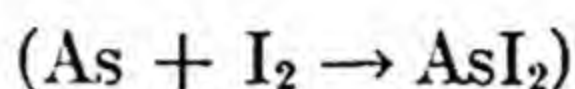
25

As

I₂

I-1074

A curved "Pyrex" tube is partially filled with one part of finely divided pulverized arsenic and two parts of iodine. Air is evacuated by means of a suction pump and the tube is then filled with dry hydrogen gas. The tube is sealed and heated to the boiling point of the mixture for two hours. Arsenic diiodide is formed.



T. Karantassis, *Bull. Soc. Chim.* (4), **37**, 853 (1925)

31

Ref., *J. Chem. Soc. (London)*, **128**, 994 (1925)

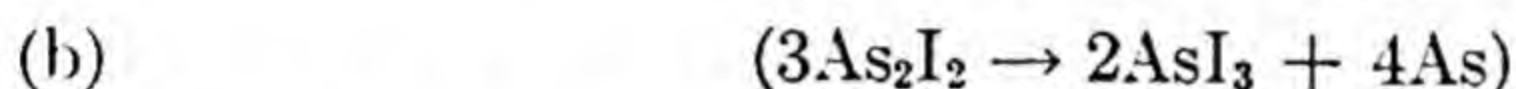
1

As

I₂

I-1075

Arsenic, heated with twice its weight of iodine in sealed tubes at 260° yields arsenic monoiodide when recrystallized from carbon disulfide in an atmosphere of carbon dioxide. The compound easily decomposes to give arsenic triiodide.



Bamberger and Philipp, *Ber.*, **14**, 2643 (1881)

109

Ref., Hewitt and Winmill, *J. Chem. Soc. (London)*, **91**, 962 (1907)

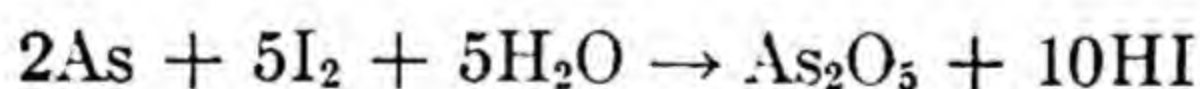
103

As

I₂

I-1076

Finely divided arsenic in benzene, such as that formed by reduction with hypophosphite, is quantitatively oxidized by iodine in water solution.



B. S. Evans, *Analyst.*, **52**, 567 (1927)

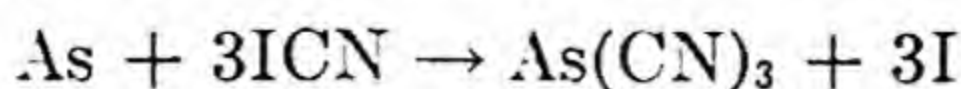
40

As

ICN

I-1077

Arsenic cyanide is formed when very finely powdered arsenic and iodine cyanide are heated with carbon disulfide in a melting tube.



E. Geuenez, *Compt. rend.*, **114**, 1186

Ref., Alex Naumann, *Ber.*, **25**, 561 (1893)

25

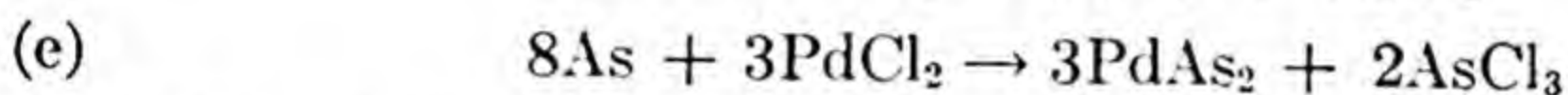
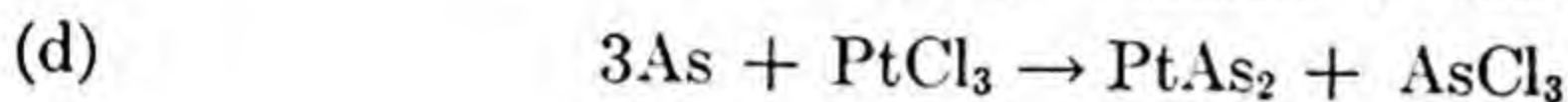
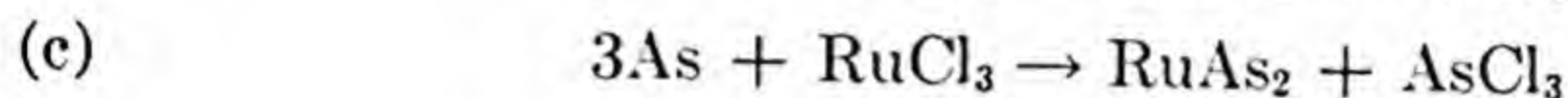
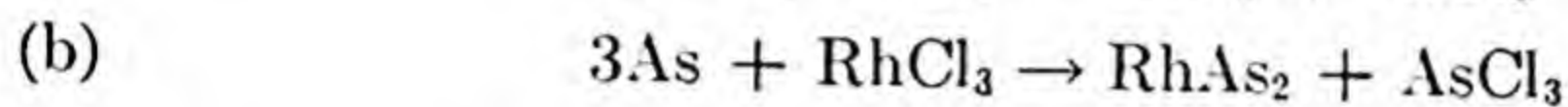
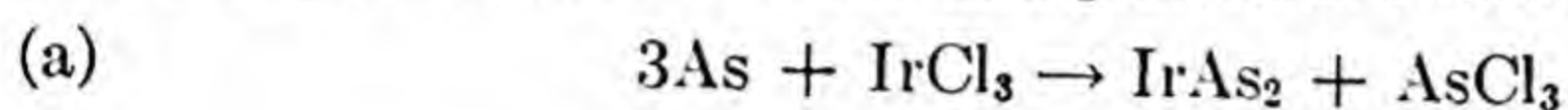
As

IrCl₃

I-1078

RhCl₃RuCl₃PtCl₃PdCl₂

By heating a mixture of arsenic and iridium trichloride in a hydrogen atmosphere at a temperature of 500–560° iridium diarsenide is obtained. The same type reaction occurs with rhodium trichloride, ruthenium trichloride, platinum trichloride and palladous chloride.



L. Wöhler and K. F. A. Ewald, *Z. anorg. Chem.*, **199**, 57 (1931)

28

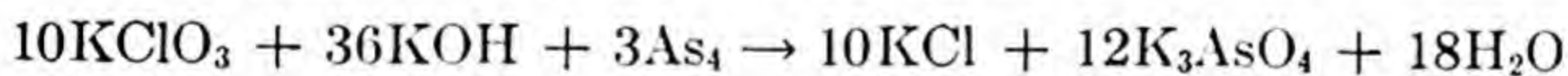
As

KClO₃

I-1079

KOH

A mixture of potassium chlorate, potassium hydroxide and arsenic is fused carefully, yielding potassium arsenate.



Schulze, *J. Prakt. Chem.*, **21**, 432 (1880)

25

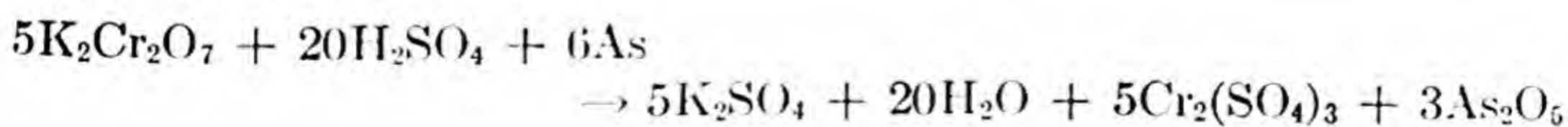
As

K₂Cr₂O₇

I-1080

H₂SO₄

Arsenic may be determined by oxidation with potassium dichromate and sulfuric acid at 60°.



Berntrop, *Chem. Weekblad.*, **3**, 315

Ref., *J. Am. Chem. Soc.*, **30**, 437 (1908)

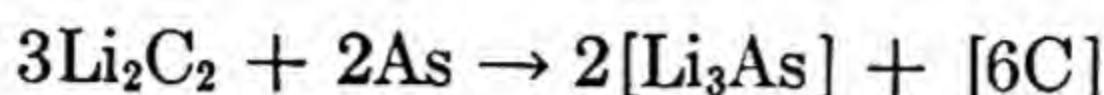
1

As

Li₂C₂

I-1081

Lithium carbide burns in arsenic vapor at red heat, yielding lithium arsenide.



H. Moissan, *Compt. rend.*, **122**, 362 (1896)

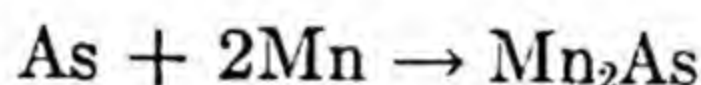
2

As

Mn

I-1082

A manganese arsenide is formed when a mixture of manganese and arsenic is heated.



Wedekind and Veit, *Ber.*, **44**, 2663 (1911)

Ref., Kane, *Pogg. Ann.*, **19**, 145

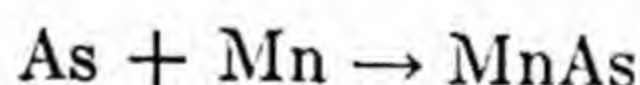
25

As

Mn

I-1083

Grayish-black powdered manganese arsenide is formed when a mixture of manganese and arsenic is heated in a closed tube at 750° for ten hours.



Hilpert and Dieckmann: *Ber.*, **44**, 2378 (1911)

25

As

Mo

I-1084

W

By heating a mixture of arsenic (3.72 g) and molybdenum (2 g) in a sealed tube for 36 hours at 570° a black colored powder, molybdenum diarsenide, is formed. The same type reaction occurs with tungsten.



E. Heinerth and W. Biltz, *Z. anorg. Chem.*, **198**, 168 (1931)

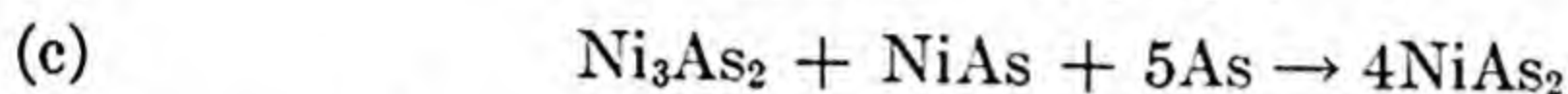
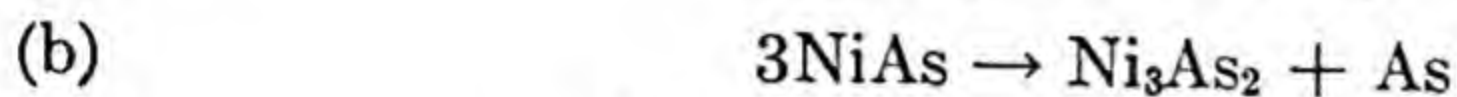
28

As

Ni

I-1085

A series of nickel arsenides may be obtained by saturating nickel with arsenic in a current of hydrogen. Each one, treated with arsenic chloride, yields NiAs and Ni₃As₂, and likewise these two arsenides are respectively formed when the nickel arsenides are heated to 400–800° and 800–1400°, the former changing into the latter also at temperatures above 100°, (a, b). Finally, heated in the presence of arsenic and hydrogen above 400°, these compounds may form a higher arsenide, (c).



E. Vigouroux, *Compt. rend.*, **147**, 427–8 (1908)

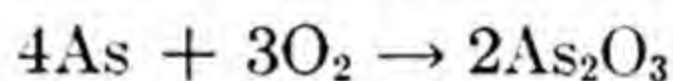
38

As

O₂

I-1086

Arsenic burned in either dry or wet oxygen forms arsenic trioxide.



H. Brereton Baker, *Trans. Roy. Soc. (London)* **179A**, 571–91 (1889)

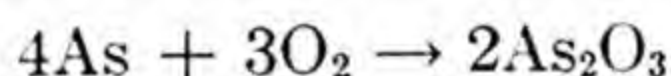
105

As

O₂

I-1087

At a temperature somewhat over 200° arsenic exhibits phosphorescence, like that of phosphorus and sulfur, due to oxidation.



Joubert, *Compt. Rend.*, **78**, 1853 (1874)

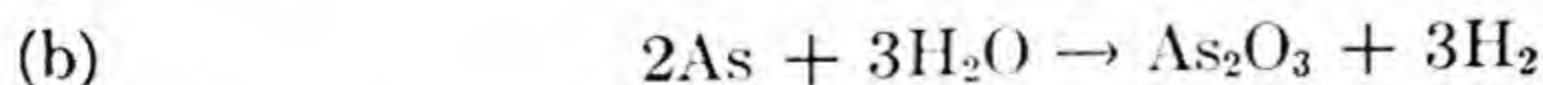
29

As

O₂

I-1088

When arsenic is heated in air it is largely oxidized to As₂O₃. Water vapor which is always present in the air may aid in the oxidation.



H. M. Elsey, *Science*, **66**, 300 (1927)

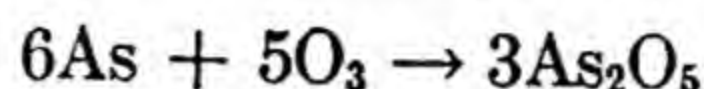
44

As

O₃

I-1089

Arsenic is oxidized to arsenic acid anhydride by ozone.



C. F. Schönbein, *Ann.*, **89**, 288 (1854)

Ref., Y. Yamauchi: *Am. Chem. J.*, **49**, 58 (1913)

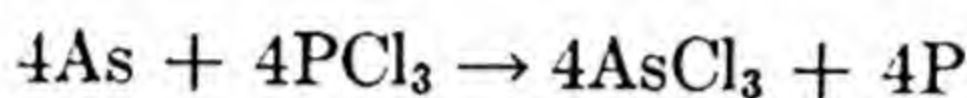
25

As

PCl₃

I-1090

Arsenic trichloride and phosphorus are formed when a mixture of phosphorus trichloride and arsenic is heated to 200° for 12 hours in an atmosphere of carbon dioxide.



Krafft and Neumann: *Ber.*, **34**, 565 (1901)

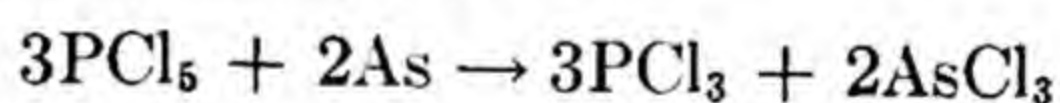
25

As

PCl₅

I-1091

Arsenic in powder form decomposes phosphorus pentachloride very easily. The mixture is slightly heated. The reaction is instantaneous and exothermic. The resulting liquid is composed of phosphorus trichloride and arsenic trichloride.



E. Baudrimont, *Ann. d. Chim. Phys.*, (4), **2**, 11 (1864)

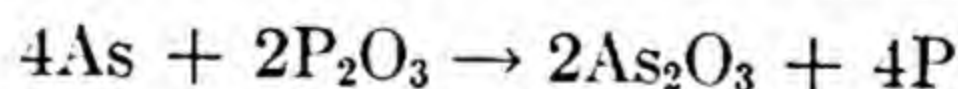
70

As

P₂O₃

I-1092

Arsenic trioxide and phosphorus are formed when phosphorus trioxide is heated with an excess of arsenic to 290° for six hours.



Krafft and Neumann: *Ber.*, **34**, 565 (1901)

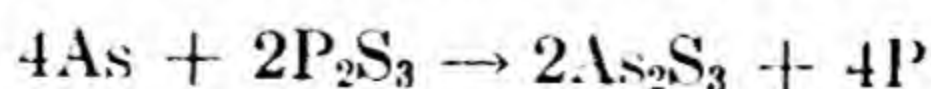
25

As

P₂S₃

I-1093

Arsenic trisulfide and phosphorus are formed when a mixture of phosphorus trisulfide and arsenic is heated to 240° in a melting tube.



Krafft and Neumann: *Ber.*, **34**, 565 (1901)

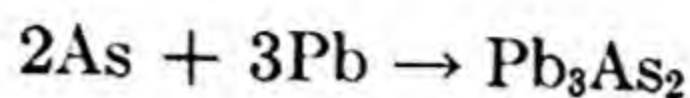
25

As

Pb

I-1094

Lead arsenide is formed when a mixture of lead filings and arsenic is subjected to pressure.



W. Spring, Ber., **16**, 324 (1883)

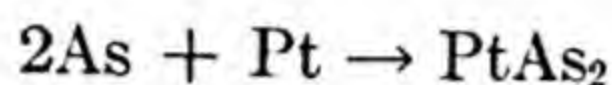
25

As

Pt

I-1095

Platinum arsenide is formed when an excess of arsenic and platinum are heated in a sealed tube.



L. Wöhler, Z. anorg. Chem., **186**, 324 (1930)

28

As

S

I-1096

When an excess of sulfur is melted with arsenic a persulfide is formed, which on distillation yields first arsenic pentasulfide, which in turn decomposes to arsenic trisulfide and sulfur on further heating.



A. Gelis,
Ref., A. Henninger, Ber., **6**, 677 (1873)

11

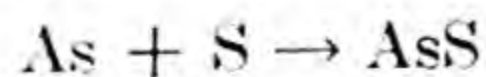
As

S

I-1097

When sulfur and an excess of arsenic are melted together the monosulfide is formed.

It is a coral red compound which differs from realgar.



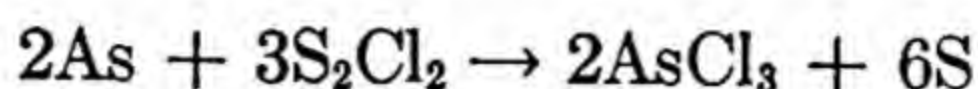
R. Gelis,
Ref., A. Henninger, Ber., **6**, 677 (1873)

11

As

S₂Cl₂**I-1098**

When powdered arsenic is added in small amounts to sulfur monochloride a yellow liquid results, which, on distillation at 130°, yields arsenic trichloride.



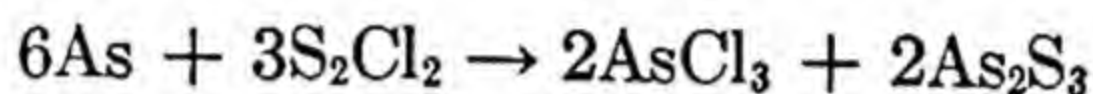
Chevrier, *Compt. Rend.*, **63**, 1004 (1866)

29

As

S₂Cl₂**I-1099**

Arsenic trichloride is obtained when powdered arsenic is heated with sulfur monochloride.



Wöhler, *Ann.*, **73**, 375 (1850)

1

As

SOCl₂**I-1100**

Arsenic trichloride is obtained when arsenic and thionyl chloride are heated together in a sealed tube at 150°.



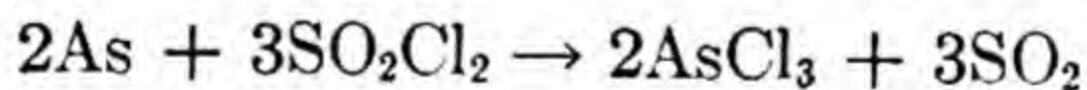
North and Hageman: *J. Am. Chem. Soc.*, **34**, 894 (1912)

1

As

SO₂Cl₂**I-1101**

Arsenic trichloride is obtained when arsenic is heated in a mixed atmosphere of sulfuryl chloride and carbon dioxide at a temperature of 170°.



P. Kochlin and K. Heumann, *Ber.*, **15**, 1736 (1882)

25

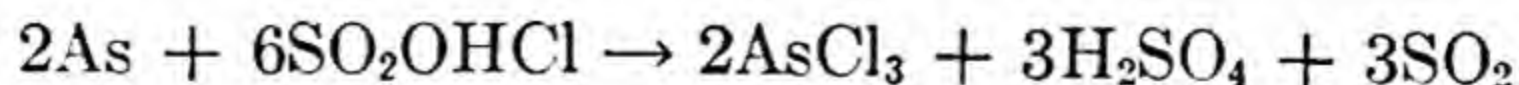
Ref., H. Danneel and F. Schlottmann, *Z. anorg. Chem.*, **212**, 225 (1933)

28

As

SO₂OHCl**I-1102**

Chlorosulfonic acid reacts with arsenic when warmed, causing a lively evolution of sulfur dioxide, and the formation of arsenic trichloride.



K. Heumann and P. Kochlin, *Ber.*, **15**, 418 (1882)

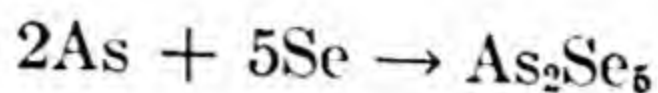
25

As

Se

I-1103

By melting together arsenic and selenium, arsenic pentaselenide of red brown color is obtained.



A. Clever and W. Muthmann, *Z. anorg. Chem.*, **10**, 117 (1895)

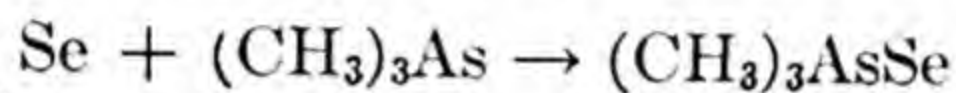
28

 $(\text{CH}_3)_3\text{As}$

Se

I-1104

Trimethyl arsenic selenide is formed when finely powdered selenium is added to an ether solution of trimethyl arsine.



Renshaw and Holm, *J. Am. Chem. Soc.*, **42**, 1471 (1920)

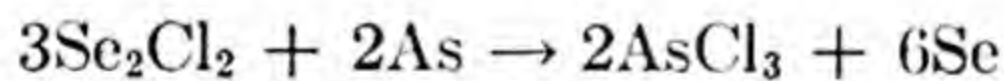
1

As

 Se_2Cl_2

I-1105

Arsenic reacts with selenium monochloride in the cold, producing arsenic trichloride and selenium.



Lenher and Kao, *J. Am. Chem. Soc.*, **48**, 1553 (1926)

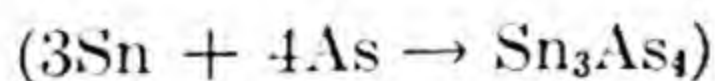
1

As

Sn

I-1106

By submitting tin and arsenic to high pressure, the substance shown below is formed:



Spring, *Ber.*, **16**, 324 (1883)

Ref., Quasim A. Mansuri, *J. Chem. Soc.*, **123**, 214 (1923)

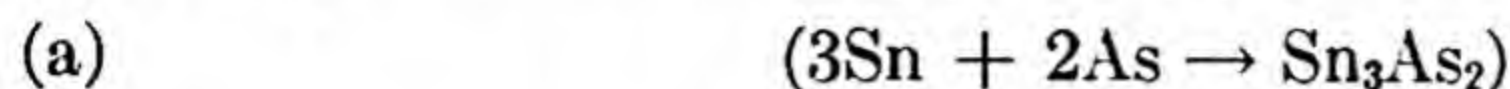
48

As

Sn

I-1107

The melting point of tin is raised by the addition of arsenic. Breaks in the tin-arsenic melting point curve seem to indicate the formation of the two compounds shown in (a) and (b) respectively:



Parravano and de Cesaris, *Rend. R. Acc. Lincei*, **20**, 593 (1911-5)

Ref., Quasim A. Mansuri, *J. Chem. Soc.*, (London) **123**, 215 (1923)

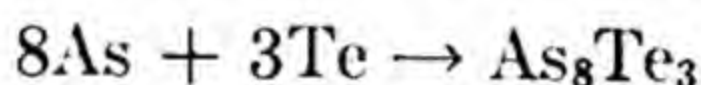
48

As

Te

I-1108

Arsenic and tellurium were mixed in the proportions 8:3 and the mixture heated in a sealed tube until the tellurium is vaporized. Upon cooling it was found that the compound octarsenotelluride was formed.



Szarvasy and Messinger. *J. Chem. Soc.* (London) **75**, 598 (1899)

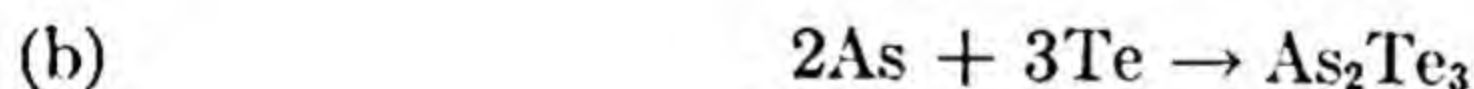
03

As

Te

I-1109

The following tellurides have been prepared by direct union of the elements.



Oppenheim, *J. Prakt. Chem.*, **71**, 278 (1857)

Ref., Szarvassi and Messinger, *Ber.*, **30**, 1343 (1897)

Ref., C. A. Tibbals, Jr., *J. Am. Chem. Soc.*, **31**, 910 (1909)

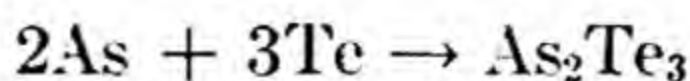
1

As

Te

I-1110

Molten tellurium dissolves readily in arsenic. The mixture forms arsenic tritelluride with a melting point of 362°.



H. Pélabon, *Compt. rend.*, **146**, 1398 (1908)

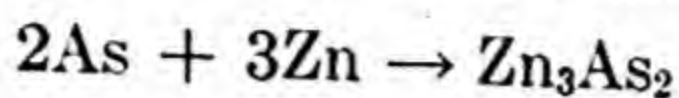
38

As

Zn

I-1111

Zinc arsenide is formed when a mixture of zinc filings and powdered arsenic is subjected to a pressure of 6500 atmospheres.



W. Spring, Ber., **16**, 324 (1883)

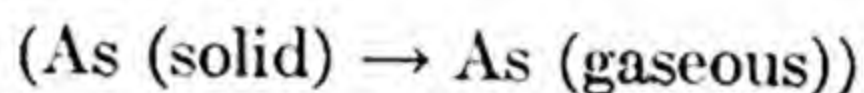
25

As

Δ

I-1112

Under ordinary circumstances, arsenic passes from the solid to the gaseous state at about 450°.



Quasim A. Mansuri, J. Chem. Soc. (London), **123**, 215 (1923)

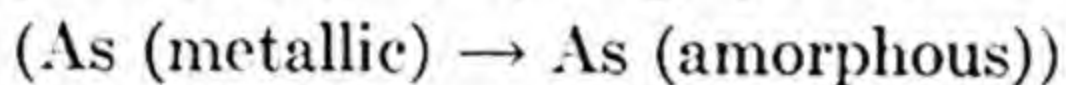
48

As

Δ

I-1113

When metallic arsenic is sublimed, amorphous arsenic is deposited in three distinct forms, in the following order: first, a mirror-like deposit, then dark brown specks, and finally a gray crust.



Porphyry N. Laschtschenko, J. Chem. Soc. (London), **121**, 972 (1922)

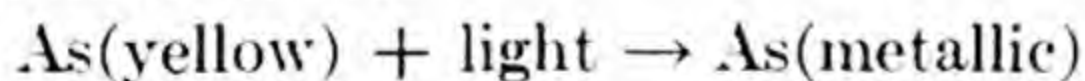
48

As

Light

I-1114

Yellow arsenic is unstable in both violet and red light, and is slowly converted to metallic arsenic.



H. Erdmann and R. Reppert, Ann., **361**, 1 (1908)

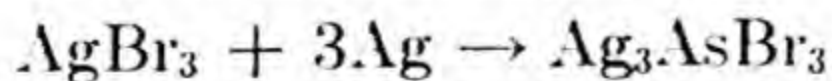
28

AsBr₃

Ag

I-1115

A mixture of carefully purified metallic silver and arsenic tribromide was heated in a sealed tube. An analysis of the resulting product showed that it was silver bromoarsenite.



S. Hilpert and F. Hermann, Ber., **46**, 2218 (1913)

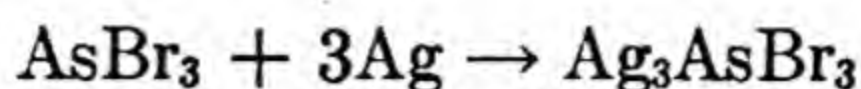
25



Ag

I-1116

A peculiar type of compound is formed when molecular silver is shaken with arsenic tribromide.



Hilpert and Herrmann: Ber., **46**, 2218 (1913)

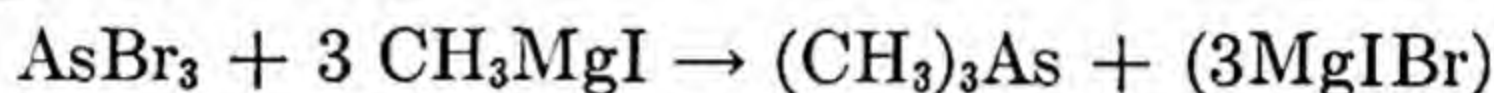
Ref., J. L. Howe, J. Am. Chem. Soc., **36**, 241 (1914)

1

CH₃MgI

I-1117

Trimethyl arsine is obtained when arsenic tribromide reacts with methyl magnesium iodide.



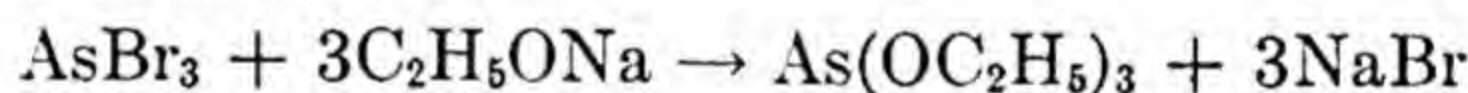
Renshaw and Holm, J. Am. Chem. Soc., **42**, 1469 (1920)

1

C₂H₅ONa

I-1118

When sodium ethylate reacts with arsenic tribromide (excess), triethoxy arsine is formed.



Crafts,

Ref., Ch. Friedel, Ber., **3**, 621 (1870)

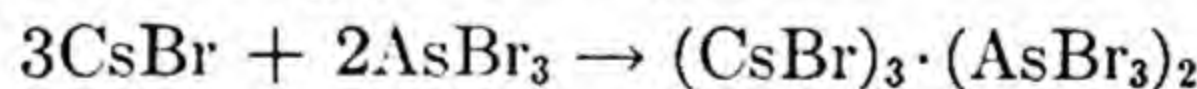
11



CsBr

I-1119

A hot solution of cesium bromide in hydrobromic acid will react with arsenic tribromide yielding yellow crystals.



H. L. Wheeler, Z. anorg. Chem., **4**, 451 (1893)

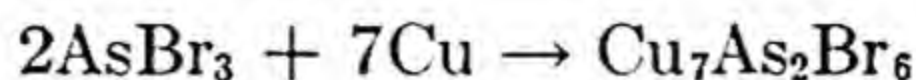
28



Cu

I-1120

An addition product is obtained when finely divided copper is heated in a melting tube with a large excess of melted arsenic tribromide on the water bath and then shaken.



Hilpert and Herrmann: Ber., **46**, 2218 (1913)

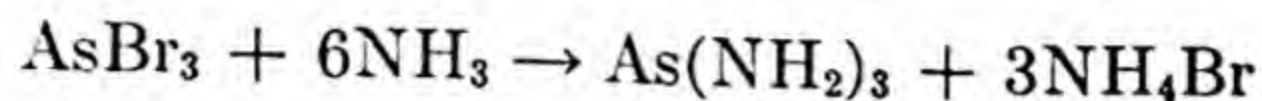
25



NH₃

I-1121

Arsenamide is formed along with ammonium bromide when ammonia reacts with arsenic tribromide at 30 to 40°C.



Hugot, Compt. rend., **139**, 54 (1904)

Ref., J. Chem. Soc. (London), **86**, 559 (1904)

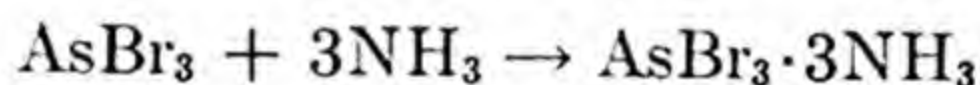
25



NH₃

I-1122

A straw yellow substance, arsenic tribromide triammoniate, is obtained if one allows arsenic tribromide to volatilize in an atmosphere of ammonia, and then allows the product to stand over sulfuric acid.



Besson, Compt. rend., **110**, 1258

Ref., A. Reissert, Ber., **23**, 549 (1890)

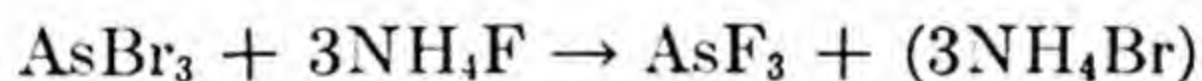
25



NH₄F

I-1123

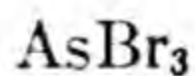
Ammonium fluoride reacts with arsenic tribromide to form arsenic trifluoride.



McIvor, Ber., **8**, 1466 (1875)

Ref., R. Gerstl, Ber., **8**, 1466 (1875)

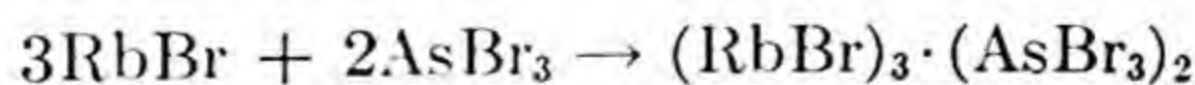
26



RbBr

I-1124

Yellow crystals are obtained when a hot solution of rubidium bromide reacts with arsenic tribromide.



H. L. Wheeler, Z. anorg. Chem., **4**, 451 (1893)

28

AsBr₃

RbBr

I-1125

Rubidium arsenic bromide is formed when crystals of arsenic tribromide are dropped into a strong hot solution of rubidium bromide in 40% hydrobromic acid.



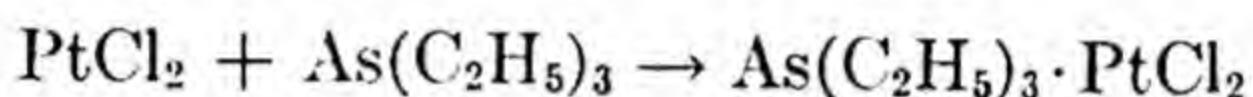
Wheeler, Z. anorg. Chem., **4**, 451 (1893)

25

As(C₂H₅)₃PtCl₂

I-1126

If, to a concentrated aqueous solution of platinum dichloride (to which an equal volume of alcohol has been added) one adds drop by drop some triethylarsine, with vigorous stirring after each addition, a reaction takes place which imparts a light yellow color to the solution. Upon cooling, sulfur-yellow crystals are deposited which can be separated by ether into two distinct compounds, one dissolving easily, the other being completely insoluble, but dissolves in boiling alcohol. Analysis shows these two substances to be isomers.



A. Cahours and H. Gal, Compt. Rend., **71**, 210 (1870)

29

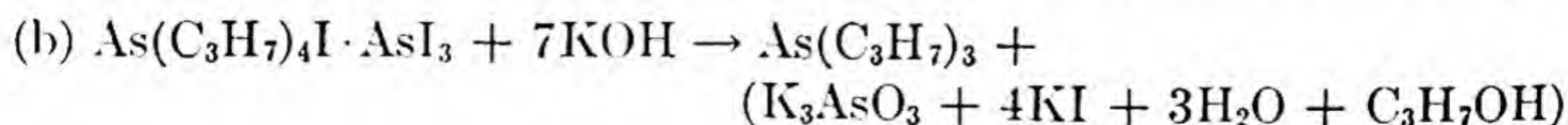
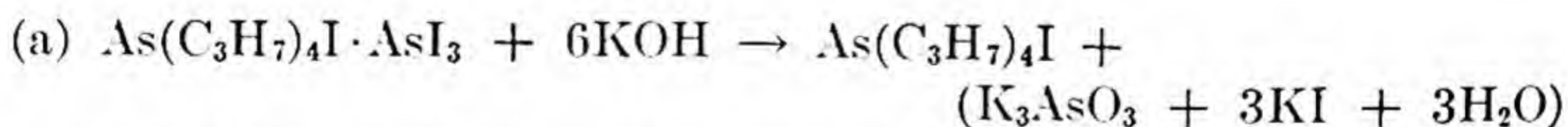
As(C₃H₇)₄I · AsI₃

KOH

I-1127

Cold potassium hydroxide decomposes the double compound of tetrapropyl arsonium iodide-arsenic triiodide to form tetrapropyl arsonium iodide and potassium arsenite, (a).

Hot potassium hydroxide in excess decomposes the double compound to form the propyl arsine, (b).

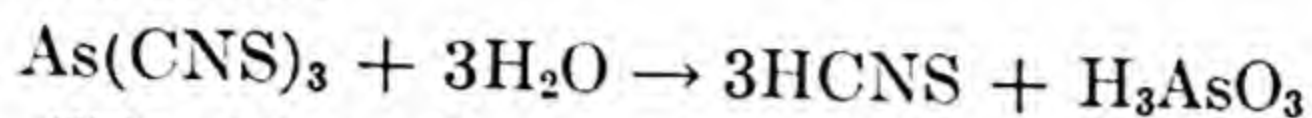


A. Cahours,
Ref., A. Henninger, Ber., **6**, 568 (1873)

11

**H₂O****I-1128**

Arsenic thiocyanate decomposes when exposed to steam into thiocyanic acid and arsenious acid.

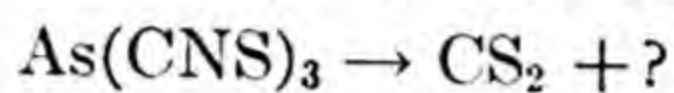


P. Miquel: *Ann. Chim. Phys.*, **11**, 351 (1877)

25

**Δ****I-1129**

Carbon disulfide was formed when arsenic thiocyanate was heated.

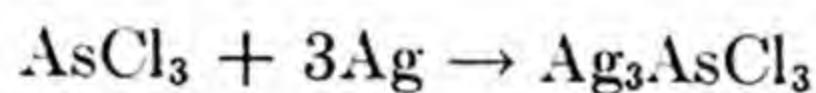


P. Miquel, *Ann. chim. phys.*, **11**, 351 (1877)

25

**Ag****I-1130**

A double compound is obtained when metallic silver is heated in a melting tube with a large excess of melted arsenic trichloride on a water bath.

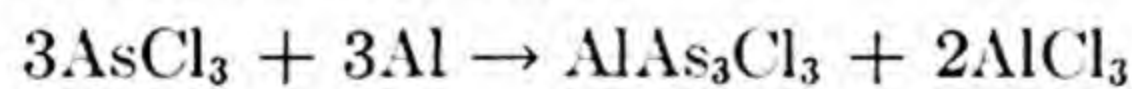


Hilpert and Herrmann: *Ber.*, **46**, 2218 (1913)

25

**Al****I-1131**

Aluminum triarsenic trichloride is obtained when arsenic trichloride is heated with aluminum in the presence of aluminum chloride for 40 minutes at a temperature of 130–150°.

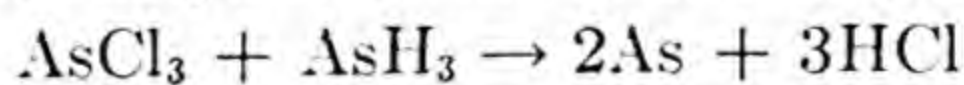


Ruff and Staib, *Z. anorg. Chem.*, **117**, 191 (1921)

28

**AsH₃****I-1132**

Arsenic trichloride decomposes arsine to arsenic and hydrogen chloride.



Jac. V. Janowsky, *Ber.*, **6**, 219 (1873)

Ref., J. Tarible, *Compt. rend.*, **132**, 207 (1901)

11

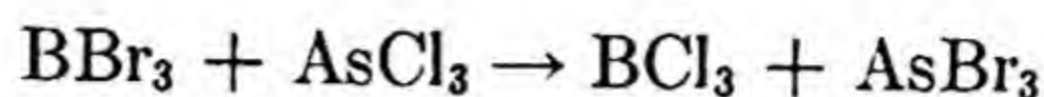
Ref., Stock, *Ber.*, **34**, 949 (1901)

25



BBr₃**I-1133**

Boron tribromide undergoes double decomposition with arsenic trichloride.

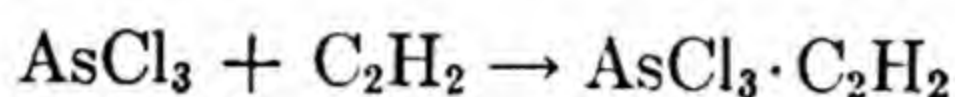


J. Tarible, *Compt. rend.*, **116**, 1521 (1893)

25

AsCl₃**C₂H₂****I-1134**

If arsenic trichloride reacts with acetylene in the presence of aluminum chloride, the addition compound, whose formula is shown below, is formed.



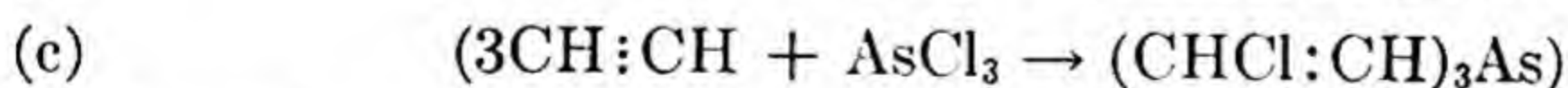
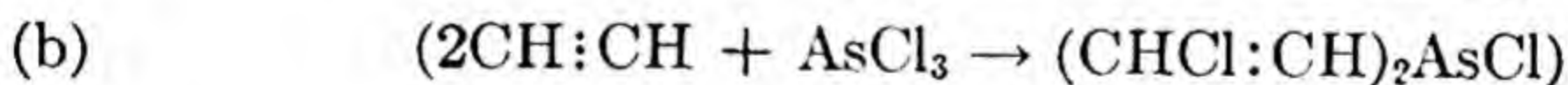
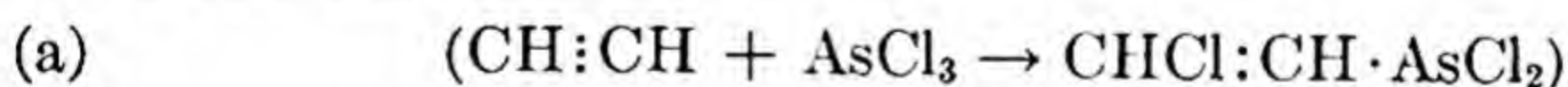
Dafert, *Monatsh.*, **40**, 313 (1919)

Ref., Stanley J. Green and Thomas S. Price, *J. Chem. Soc.*, (London), **119**, 448 (1921)

48

AsCl₃**C₂H₂****I-1135**

A current of acetylene is bubbled through a cooled solution of arsenic trichloride and aluminum chloride. The product is a dark colored viscid mass, which is decomposed immediately upon addition of ice-cold hydrochloric acid. An oil separates out, containing unchanged arsenic trichloride and several chloro-vinyl-chloroarsines: (a) β -chloro-vinyl-dichloroarsine, (b) $\beta\beta'$ -dichloro-divinyl-chloroarsine, (c) $\beta\beta'\beta''$ -trichloro-trivinyl-arsine.



Stanley J. Green and Thomas S. Price, *J. Chem. Soc.* (London), **119**, 448, 449 (1921)

48

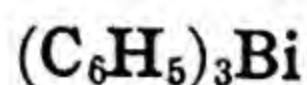
AsCl₃**(C₆H₅)₃As****I-1136**

Monophenyl arsenic dichloride is formed when triphenyl arsine is heated with an excess of arsenic trichloride at 250°.



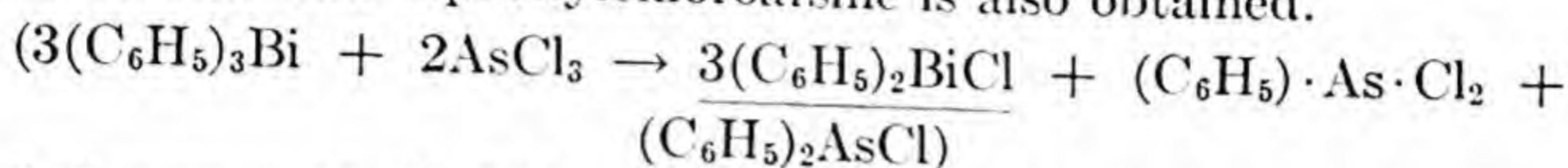
A. Michaelis and A. Reese, *Ber.*, **15**, 2876 (1882)

25



I-1137

If an ethereal solution of arsenic trichloride is slowly added to triphenyl bismuthine in the same solvent, colorless crystals of diphenylchlorobismuthine are deposited. A pale yellow oil containing phenyldichloroarsine and diphenylchloroarsine is also obtained.



F. Challenger and L. R. Ridgway, *J. Chem. Soc. (London)*, **121**, 114 (1922)

48

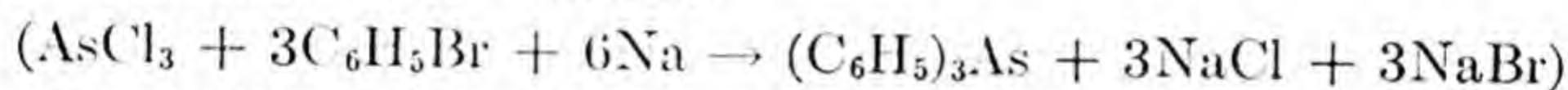


I-1138



If an ethereal solution of arsenic trichloride and bromobenzene is treated with sodium, triphenylarsine is obtained.

Chlorobenzene can be used instead of bromobenzene, and a little ethyl acetate stimulates the reaction.



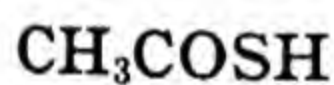
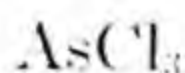
Michaelis and Reese, *Ber.*, **15**, 2876 (1882)

Ref., Philips, *Ber.*, **19**, 1031 (1886)

Ref., Michaelis, *Ann.*, **321**, 160 (1902)

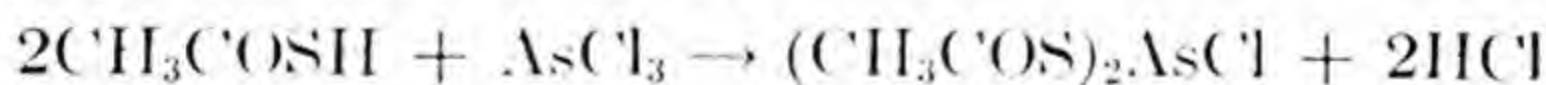
Ref., W. J. Pope and E. E. Turner, *J. Chem. Soc. (London)*, **117**, 1447-1448 (1920)

48



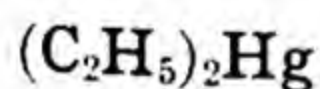
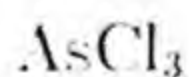
I-1139

If thioacetic acid is poured on arsenic trichloride, a drop at a time, and at the same time the temperature is kept low, arsenic chloride thioacetate and hydrochloric acid are formed.



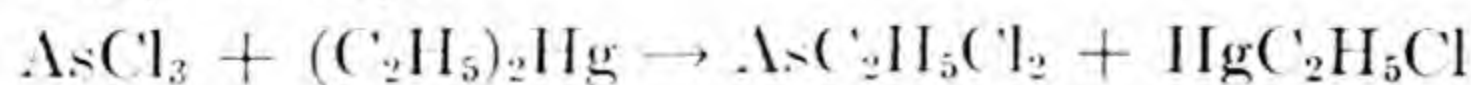
N. Tarugi, *Gazz. Chim. Ital.*, **27**, 154 (1897)

41



I-1140

Ethyl dichloroarsine can be obtained by the action of arsenic trichloride on mercury diethyl.



La Coste, *Ann.*, **208**, 33 (1881)

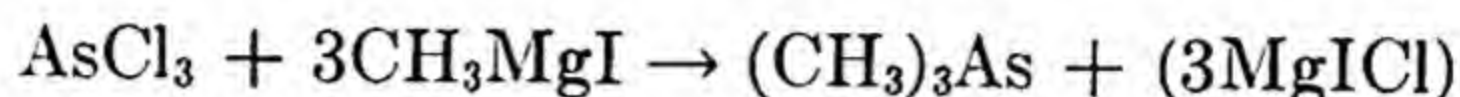
Ref., Alex. McKenzie and John K. Wood, *J. Chem. Soc. (London)*, **117**, 407 (1920)

48



I-1141

Trimethyl arsine is formed when arsenic trichloride is added to methyl magnesium iodide immersed in an ice bath.



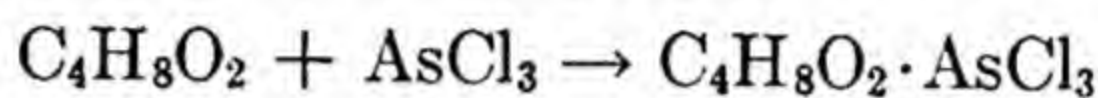
Renshaw and Holm, *J. Am. Chem. Soc.*, **42**, 1469 (1920)

1



I-1142

1.4 gm. dioxane is treated with 2.33 gm. arsenic trichloride, with cooling, preferably in absolute ether solution. A white crystalline complex precipitates. It is an oxonium compound.



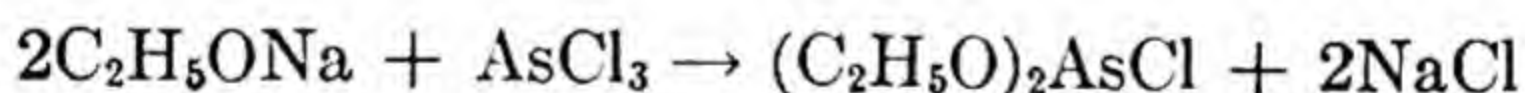
M. S. Malinovsky, *J. Gen. Chem. (USSR)*, **10**, 1202 (1940)

60



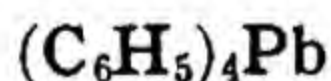
I-1143

A solution of 30 grams of sodium in 600 cc. of ethyl alcohol is added slowly to 118 grams of arsenic trichloride; the addition lasts two and one half hours, and after the solution has stood for 24 hours, the sodium chloride is removed by boiling for one hour; the product obtained is diethoxy-chloroarsine.



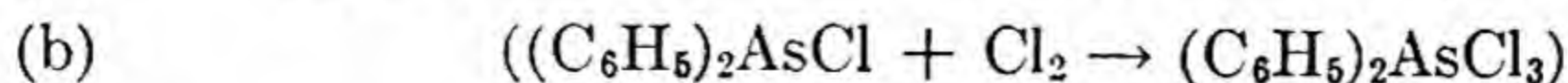
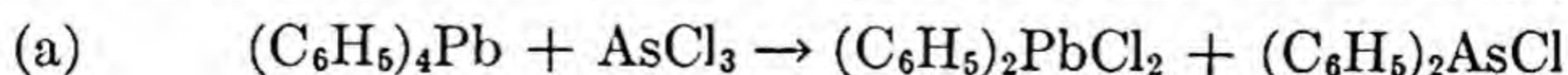
Alex. McKenzie and John K. Wood, *J. Chem. Soc. (London)*, **117**, 407 (1920)

48



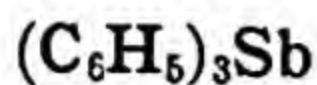
I-1144

Arsenic trichloride and lead tetraphenyl are heated in toluene for one hour under reflux. After standing for 12 hours, the mixture is warmed and filtered. The residue is found to consist of lead diphenylchloride; the filtrate gives oily diphenylarsine chloride, (a). The latter upon chlorination, yields crystals of diphenyl arsenic trichloride, (b).



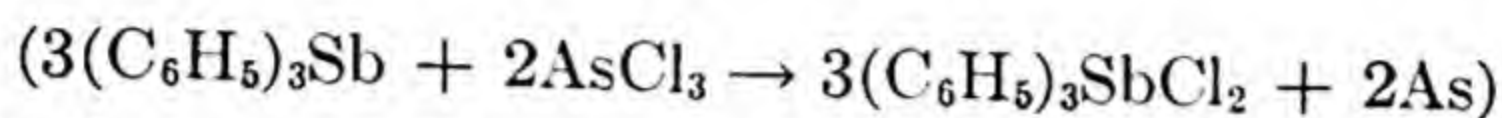
A. E. Goddard, J. N. Ashley and Richard B. Evans, *J. Chem. Soc. (London)*, **121**, 969, 980 (1922)

48



I-1145

If arsenic trichloride is treated with triphenylstibine and the mixture heated to 80° for three and one half hours, triphenyl antimony dichloride is formed. Traces of inorganic reduction products are found, and if the reagents are used in large amounts, metallic arsenic can be isolated.



Frederick Challenger and Freda Pritchard, J. Chem. Soc. (London), **125**, 871 (1924)

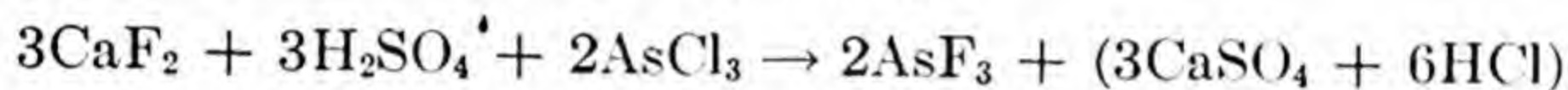
48



I-1146



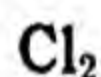
A mixture of arsenic trichloride, calcium fluoride and sulfuric acid is distilled. Arsenic trifluoride is obtained.



R. McIvor, Ber., **8**, 1466 (1875)

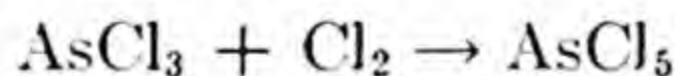
Ref., R. Gerstl. Ber., **8**, 1466 (1875)

26



I-1147

Arsenic pentachloride was obtained by treating arsenic trichloride with chlorine at a very low temperature.



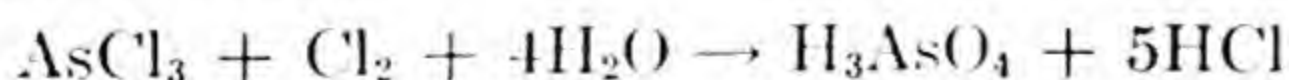
Baskerville and Bennett, J. Am. Chem. Soc., **24**, 1070 (1902)

1



I-1148

A rapid means of separating hydrochloric acid from arsenic trichloride is effected by adding an excess of chlorine which oxidizes the arsenic trichloride to arsenic acid.



A. Houzeau, Compt. Rend., **59**, 1027 (1864)

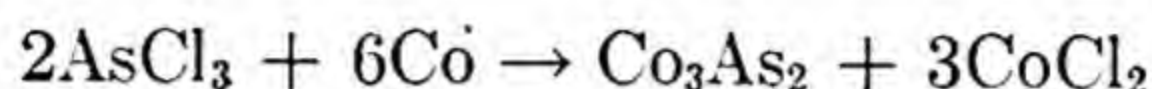
29



Co

I-1149

Tricobalt diarsenide is formed when a mixture of arsenic trichloride and metallic cobalt is heated at 800°–1400°. At a higher temperature CoAs_2 is formed.



Ducelliez, *Compt. rend.*, **147**, 424 (1908)

Ref., *J. Chem. Soc. (London)*, **94**, 853 (1908)

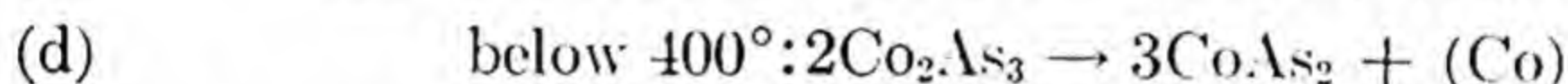
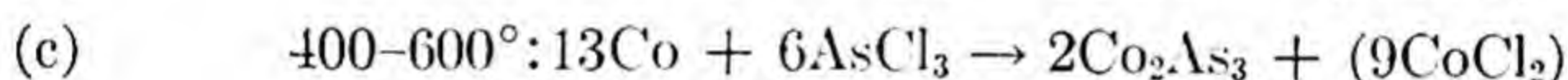
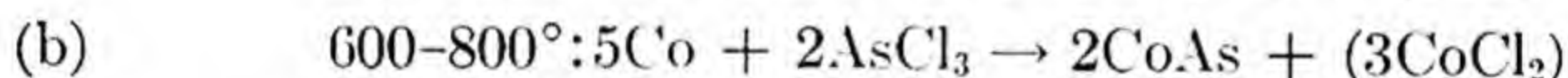
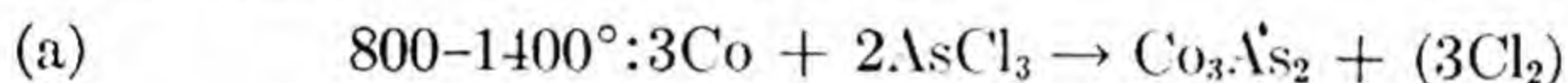
25



Co

I-1150

When arsenic trichloride is reacted with cobalt, the metal is transformed into chloride and an arsenide, the composition of which depends upon the temperature of the reaction, as shown below. The same arsenides are formed at the same temperatures when arsenic vapors react with powdered cobalt.



F. Ducelliez, *Compt. rend.*, **147**, 424 (1908)

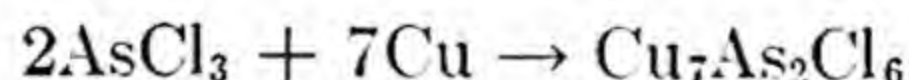
38



Cu

I-1151

An addition product is formed when finely powdered copper is heated in a melting tube with a large excess of melted arsenic trichloride on a water bath.



Hilpert and Herrmann: *Ber.*, **46**, 2218 (1913)

25

 H_2O

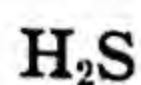
I-1152

Water hydrolyzes arsenic trichloride to form arsenic trioxide.



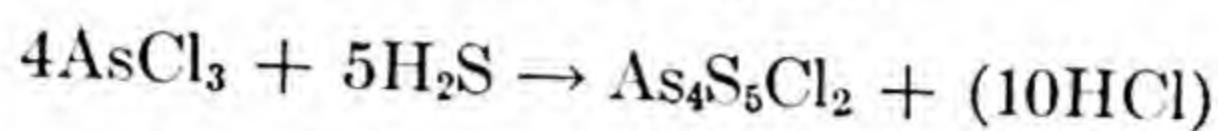
John Davy, *Trans. Roy. Soc. (London)*, **102**, 186 (1812)

105



I-1153

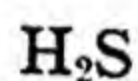
An arsenic dichlorosulfide is formed when dry hydrogen sulfide is passed into a solution of arsenic trichloride.



L. Ouvrard, *Compt. rend.*, **116**, 1516

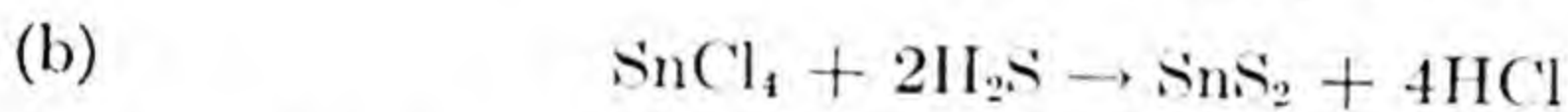
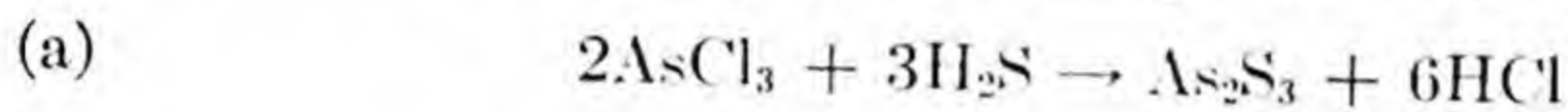
Ref., H. Hosaeus, *Ber.*, **26**, 672 (1893)

25



I-1154

Arsenic trisulfide is slowly precipitated when hydrogen sulfide gas is led into a solution of arsenic trichloride in dry benzene. The reaction is more rapid in petroleum ether. When stannic chloride is substituted for arsenic chloride, tin sulfide is precipitated over night.



L. Kahlenberg, *J. Phys. Chem.*, **6**, 1 (1902)

7



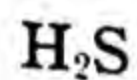
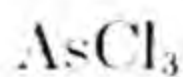
I-1155

Arsenic trichloride gives arsenic trisulfide when mixed with liquid hydrogen sulfide at all temperatures.



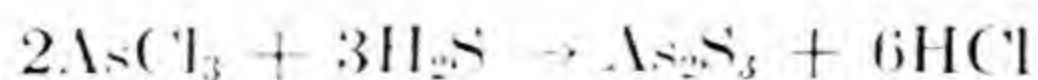
Ralston and Wilkinson, *J. Am. Chem. Soc.*, **50**, 261 (1928)

1



I-1156

Hydrogen sulfide added to a warm solution of arsenious oxide in dilute hydrochloric acid in insufficient amount to cause complete precipitation forms practically pure arsenic trisulfide.



L. F. Nilson, *K. Sv. Vet. Akad. Handl.*, **10**, 25 (1871)

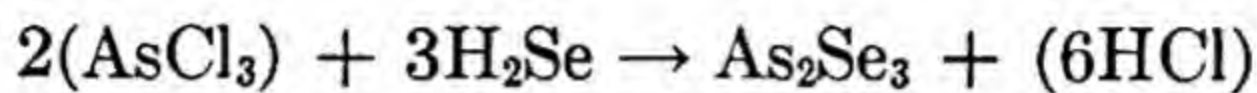
10



H₂Se

I-1157

A dark reddish brown precipitate of arsenious selenide is formed when arsenic trichloride is dropped into a pure saturated solution of hydrogen selenide.



Moser and Atynski, *Monatsh.*, **45**, 235 (1925)

Ref., *J. Chem. Soc. (London)*, **128**, 584 (1925)

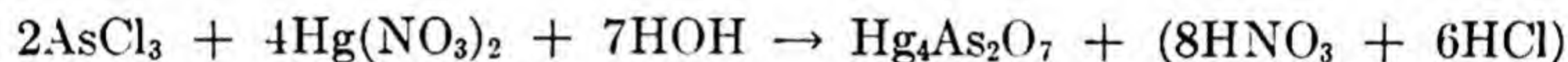
25



Hg(NO₃)₂

I-1158

A white precipitate of mercurous pyroarsenate which darkens to purplish red is formed when arsenic trichloride and mercuric nitrate are brought together.



Simon, *Pogg. Ann.*, **41**, 424

Ref., Konrad Haack, *Ann.*, **262**, 182 (1891)

25

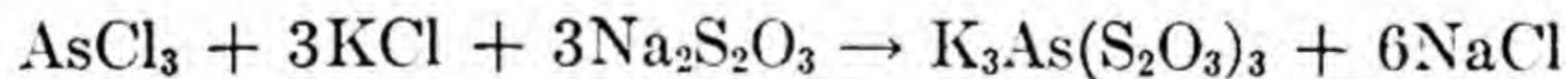


KCl

I-1159

Na₂S₂O₃

A solution of arsenic trichloride will react with potassium chloride and sodium thiosulfate yielding potassium-arsenic thiosulfate. By adding alcohol it is obtained in the form of a white precipitate.



J. v. Szilágyi, *Z. anorg. Chem.*, **113**, 75 (1920)

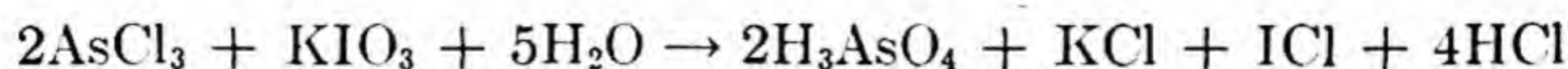
28



KIO₃

I-1160

Arsenic acid is formed when arsenic trichloride solution is titrated with potassium iodate.



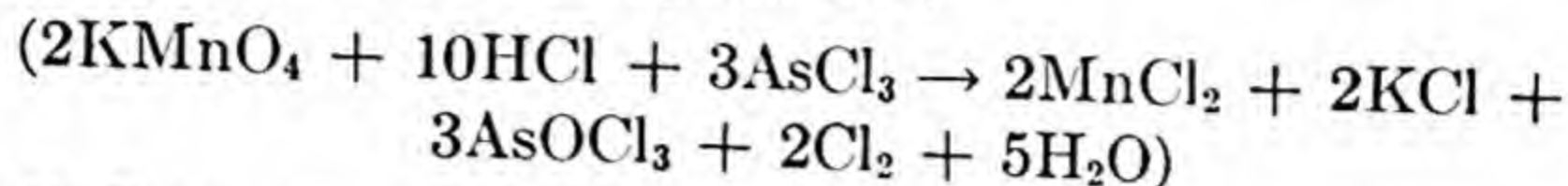
L. W. Andrews, *J. Am. Chem. Soc.*, **25**, 759 (1903)

1



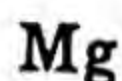
I-1161

Solutions of arsenic trichloride may be titrated with potassium permanganate in acid solution. The action of the permanganate results in the formation of arsenic oxychloride.



Reginald G. Durrant, J. Chem. Soc., (London), **115**, 136 (1919)

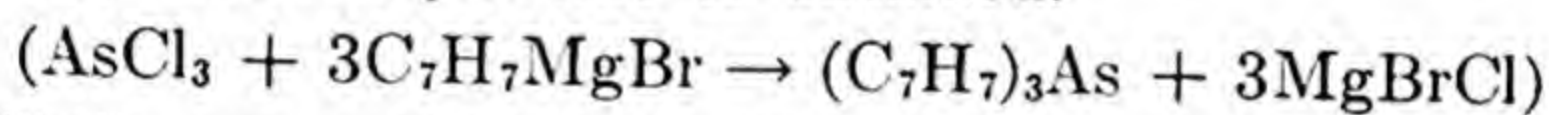
48



I-1162



Arsenic trichloride in dry benzene is gradually added to the Grignard reagent prepared from a mixture of m-bromotoluene and magnesium; the whole mixture is then heated for two hours under reflux. After removal of the by-products of steam-distillation and crystallization from alcohol, tri-m-tolylarsine is obtained.



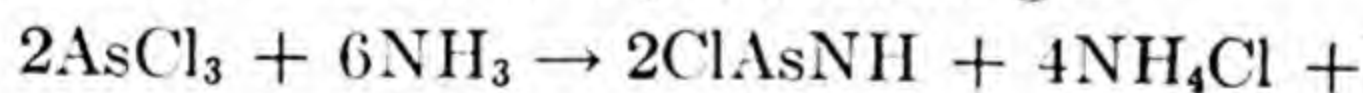
Frederick Challenger and Freda Pritchard, J. Chem. Soc., (London), **125**, 869 (1924)

48



I-1163

A mixture of chlorarsenimide and ammonium chloride is formed when arsenic trichloride is heated in dry ammonia gas.



Pasteur, J. Pharm. Chim., **13**, 395

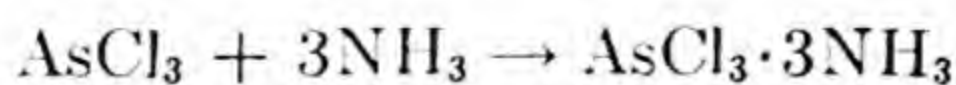
Ref., Ann. **68**, 307 (1848)

25



I-1164

A pale yellow powder is prepared when one volatilizes arsenic trichloride in an atmosphere of ammonia and allows it to stand over sulfuric acid.



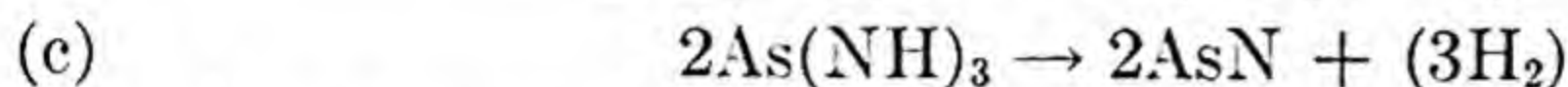
Besson, Compt. rend., **110**, 1258

Ref., A. Reissert, Ber. **23**, 549 (1890)

25

**NH₃****I-1165**

When arsenic trichloride is exhausted with liquid ammonia at low temperatures, ammonium chloride and arsenic amide are formed (a). The latter decomposes at higher temperatures to give the imide (b), then the nitride (c).



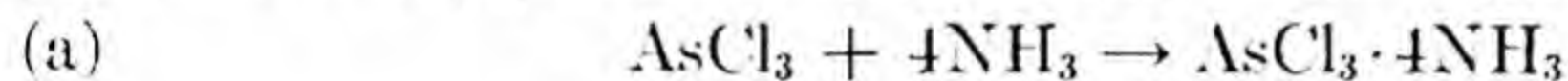
Hugo, *Compt. rend.*, **139**, 54 (1904)

Ref.: Besson and Rosset, *Compt. rend.*, **146**, 1266 (1908)

38

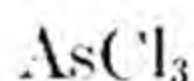
**NH₃****I-1166**

Dry ammonia gas reacts with arsenic trichloride at -20° to give a light yellow compound corresponding to the composition of the tetrammoniate, (a). Sublimation of the product in vacuo at 200° gives a yellowish horny product corresponding to the formula shown in (b).

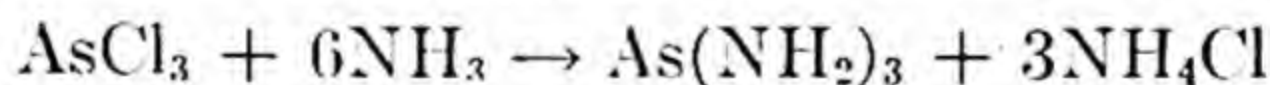


Besson and Rosset, *Compt. rend.*, **146**, 1266 (1908)

38

**NH₃****I-1167**

A grayish-white amorphous powder, arsenamide, is formed by the action of ammonia on arsenic trichloride at -30 to -40° .

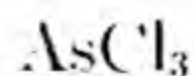


Hugot, *Compt. rend.*, **139**, 54 (1904)

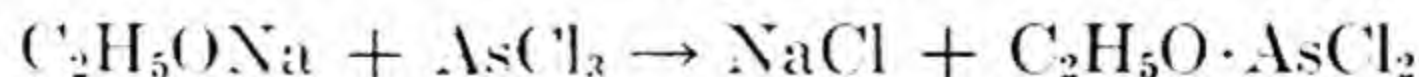
Ref., *J. Chem. Soc. (London)*, **86**, 559 (1904)

Ref., E. C. Franklin, *J. Am. Chem. Soc.*, **27**, 826 (1905)

1

**NaOC₂H₅****I-1168**

If a solution of 15 grams of sodium in 300 cc. of ethyl alcohol is gradually added, within an interval of two and a half hours, to 118 grams of arsenic trichloride ethoxydichloroarsine is formed. The sodium chloride separates after boiling the product for one hour.

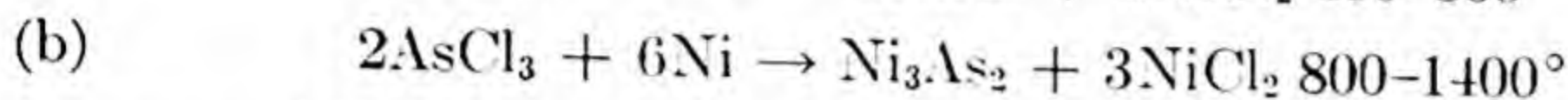
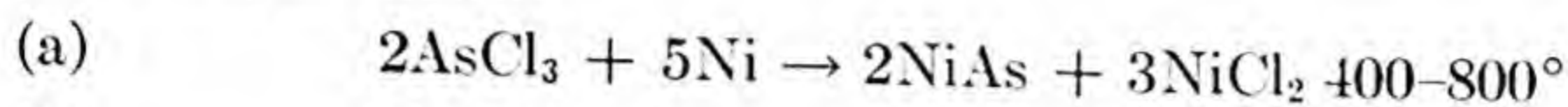


Alex. McKenzie and John K. Wood, *J. Chem. Soc. (London)*, **117**, 406 (1920)

48

**Ni****I-1169**

Arsenic trichloride vapors conducted over reduced nickel form the metal chloride and an arsenide, which depends upon the reaction temperature, as shown:



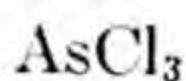
Granger and Didier, *Bull. soc. chim.*, (3), **23**, 506 (1900)

Ref., E. Vigouroux, *Compt. rend.*, **147**, 426 (1908)

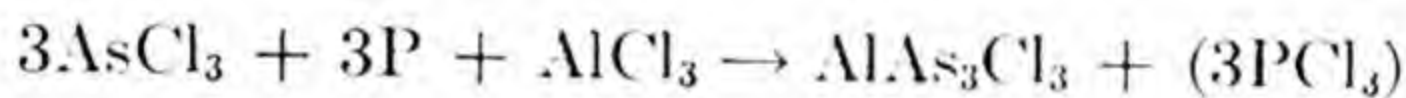
Ref., E. Horton, *J. Chem. Soc. (London)*, **94**, 855 (1908)

38

25

**P****I-1170****AlCl₃**

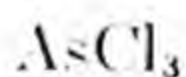
Arsenic trichloride is reduced to aluminum triarsenic trichloride by yellow phosphorus in the presence of aluminum chloride when heated in a paraffin bath at 120 to 130°.



Ruff and Staib, *Z. anorg. Chem.*, **117**, 191 (1921)

Ref., *J. Chem. Soc. (London)*, **120**, 508 (1921)

25

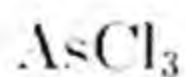
**Pb(CNS)₂****I-1171**

Arsenic thiocyanate is formed when a mixture of arsenic trichloride and lead thiocyanate is heated slowly on a sand bath.



P. Miquel, *Ann. Chim. Phys.* **11**, 351 (1877)

25

**RbCl****I-1172****HCl**

Arsenic trichloride dissolved in concentrated hydrochloric acid reacts with rubidium chloride to yield a yellow crystalline double compound.

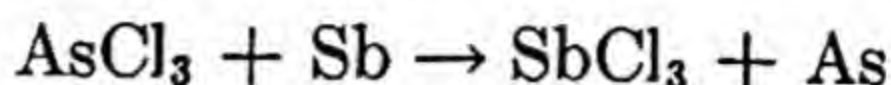


H. L. Wheeler, *Z. anorg. Chem.*, **4**, 451 (1893)

28

**Sb****I-1173**

Antimony trichloride is formed when a mixture of metallic antimony and arsenic trichloride react at 200°.

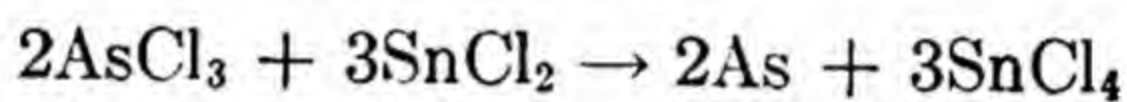


Krafft and Neumann, Ber., **34**, 565 (1901)

25

**SnCl₂****I-1174**

If equivalent weights of arsenic trichloride and stannous chloride be mixed in hydrochloric acid of sufficiently high concentration, metallic arsenic will be deposited; stannous chloride is oxidized to stannic chloride. The reaction is completed within a few hours, but no reaction occurs when the reactants are dry.

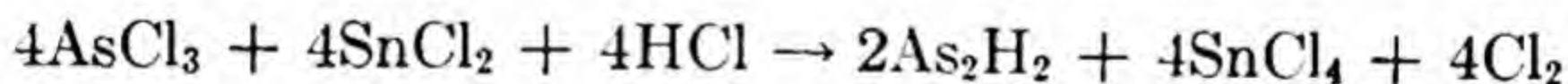


Reginald G. Durrant, J. Chem. Soc., (London), **115**, 134 (1919)

48

**SnCl₂****I-1175**

Solid arsenic hydride results when a large quantity of stannous chloride solution in ethyl ether acts upon arsenic trichloride in hydrochloric acid solution.

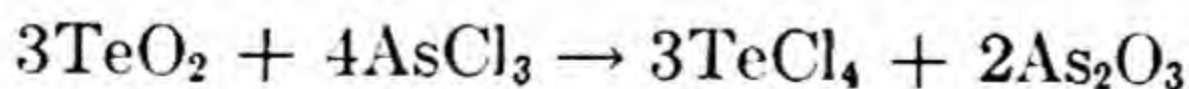


G. Druce, Chem. List., **19**, 156 (1925)

5

**TeO₂****I-1176**

Tellurium tetrachloride and arsenic trioxide are formed when tellurium dioxide is allowed to react with arsenic trichloride.

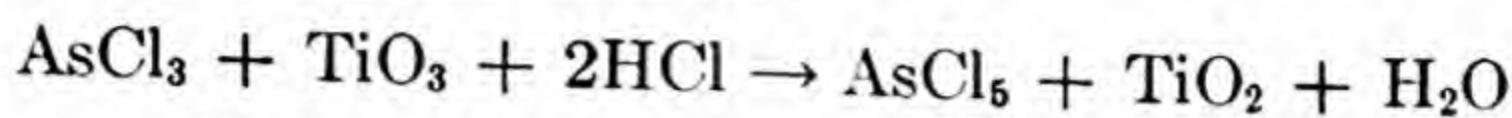


V. Lenher, J. Am. Chem. Soc., **30**, 740 (1908)

1

**TiO₃****I-1177**

Arsenic trichloride in hydrochloric acid solution is oxidized to the pentachloride by titanium trioxide.

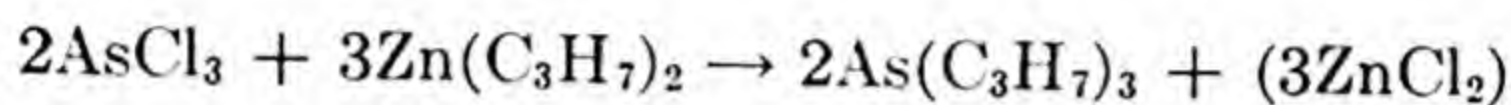


P. Faber, *Z. anal. Chem.*, **46**, 279 (1907)

28

**Zn(C₃H₇)₂****I-1178**

Arsenic trichloride reacts with dipropyl zinc to form tripropyl arsine and zinc chloride.



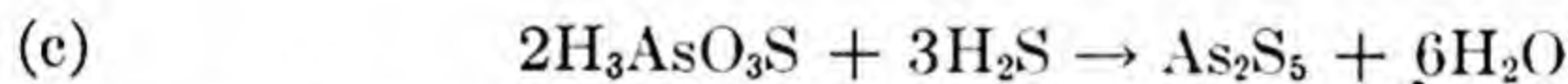
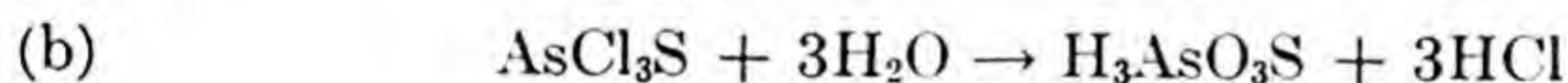
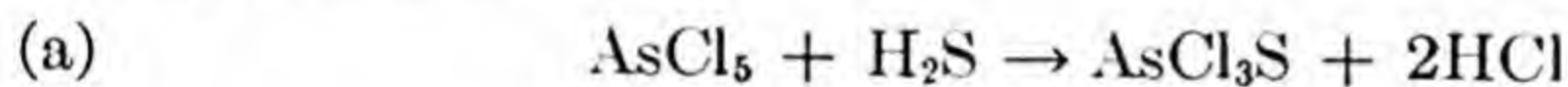
A. Cahours,

Ref., A. Henninger, *Ber.*, **6**, 568 (1873)

11

**H₂S****I-1179**

Arsenic pentasulfide is formed when arsenic pentachloride reacts with hydrogen sulfide.

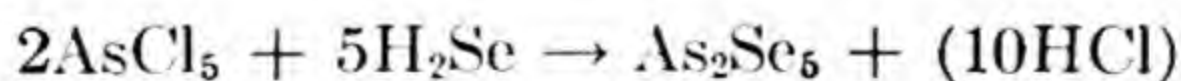


F. Neher, *Z. anal. Chem.* **32**, 45 (1893)

25

**H₂Se****I-1180**

A brownish red precipitate of arsenic pentaselenide is formed when arsenic pentachloride is dropped into a pure saturated solution of hydrogen selenide.



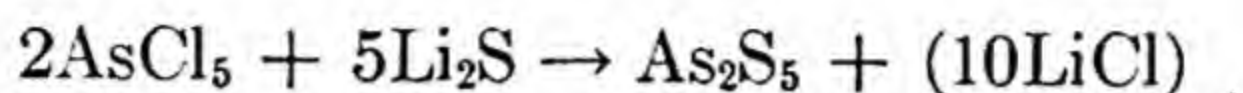
Moser and Atynski, *Monatsh.*, **46**, 235 (1925)

Ref., *J. Chem. Soc. (London)*, **128**, 584 (1925)

25

**Li₂S****I-1181**

Arsenic pentachloride attacks lithium sulfide to form arsenic pentasulfide and lithium chloride.

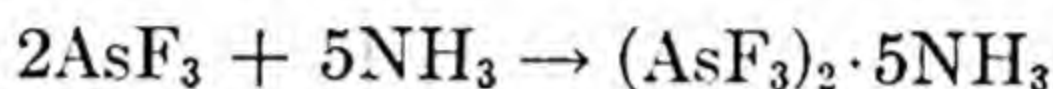


A. Mourlot, *Ann. Chim. Phys.*, (7), **17**, 510 (1899)

2

**NH₃****I-1182**

A fine white powder deposits when one volatilizes arsenic trifluoride in an atmosphere of ammonia and allows it to stand over sulfuric acid.



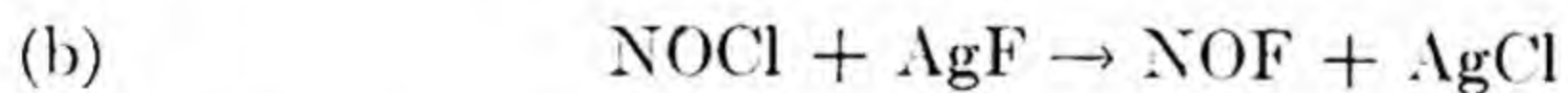
Besson: *Compt. rend.* **110**, 1258

Ref., *Ber.* **23**, 549 (1890)

25

**NOF****I-1183**

Arsenic trifluoride will react with nitrosyl fluoride yielding a crystalline addition product. The nitrosyl fluoride is obtained by the reaction of nitrosyl chloride with silver fluoride at a temperature of 250–280°.

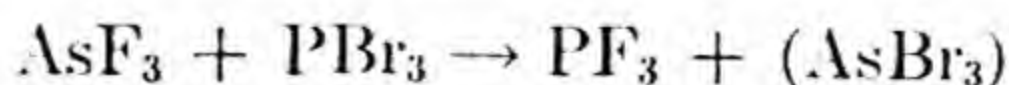


O. Ruff, *Z. anorg. Chem.*, **58**, 325 (1908)

28

**PBr₃****I-1184**

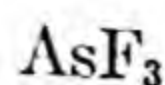
Phosphorus trifluoride is formed through the action of phosphorus tribromide upon arsenic trifluoride.



McIvor,

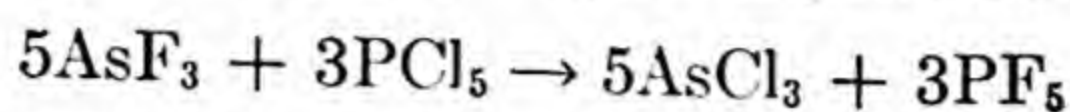
Ref., *R. Gerstl, Ber.*, **8**, 1466 (1875)

26



I-1185

Arsenic trifluoride and phosphorus pentachloride heated together in concentrated sulfuric acid give phosphorus pentafluoride.



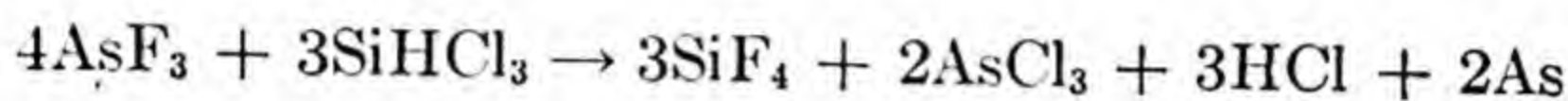
T. E. Thorpe, *Ann.*, **182**, 201 (1876)

20



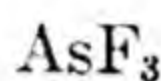
I-1186

Arsenic trifluoride is treated with silicochloroform after which elementary arsenic separates.



Ruff and Albert, *Ber.*, **38**, 53 (1905)

25



I-1187

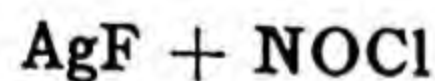
Silicon tetrafluoride and arsenic trioxide are obtained when a mixture of arsenic trifluoride and sand is heated.



H. Moissan, *Compt. rend.* **99**, 874

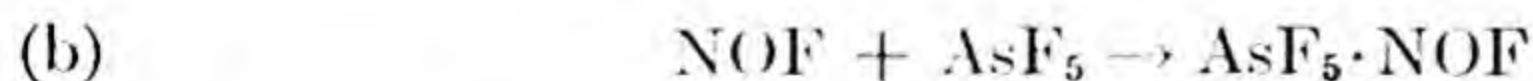
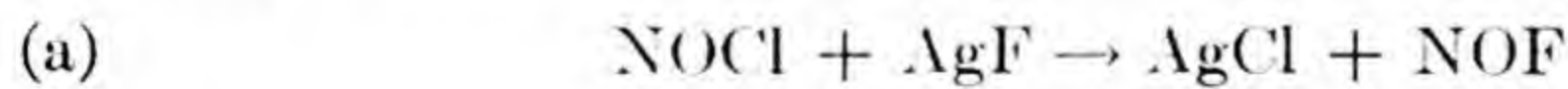
Ref., *Ber.* **17**, 601 (1884)

25



I-1188

A double compound of arsenic pentafluoride-nitrosyl fluoride is obtained when arsenic pentafluoride is passed into colloidal nitrosyl chloride treated with silver fluoride. The mixture is then warmed.



Ruff, *Z. anorg. Chem.* **58**, 325 (1908)

Ref., G. Senter, *J. Chem. Soc. (London)*, **94**, 584 (1908)

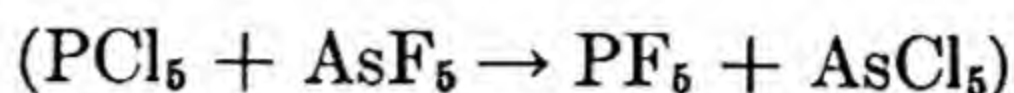
25



PCl₅

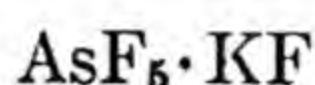
I-1189

Phosphorus pentafluoride was prepared by the action of phosphorus pentachloride on arsenic pentafluoride. The phosphorus pentafluoride was separated by distilling at 70°.



H. Moissan, *Ann. Chim. Phys.*, [VIII], **8**, 85 (1906)

100



KF

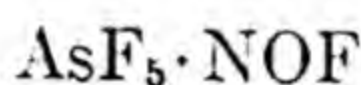
I-1190

Thick shining crystals are obtained when arsenic pentafluoride-potassium fluoride is dissolved in an excess of potassium fluoride and hydrofluoric acid.



Marignac, *Ann.*, **145**, 251 (1868)

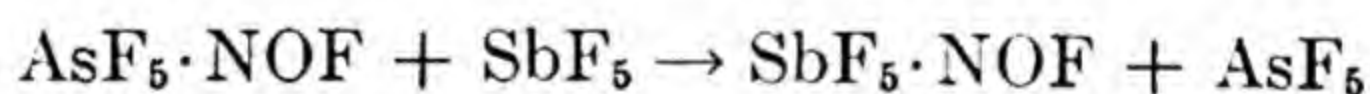
25



SbF₅

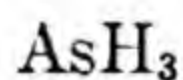
I-1191

Arsenic pentafluoride-nitrosyl fluoride will react with antimony pentafluoride when gently heated, yielding a colorless crystalline substance, antimony pentafluoride-nitrosyl fluoride.



O. Ruff, *Z. anorg. Chem.*, **58**, 325 (1908)

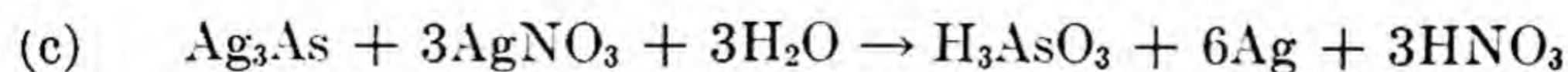
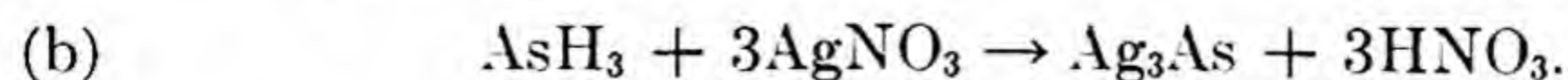
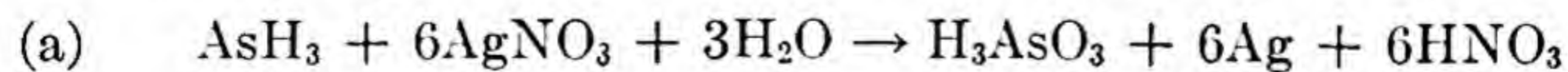
28



AgNO₃

I-1192

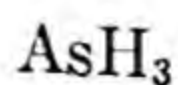
Arsine is absorbed readily by silver nitrate solution, but only slowly by mercury copper, lead, tin, and iron salt solutions.



H. Reckleben et al, *Z. anal. Chem.* **46**, 671 (1907)

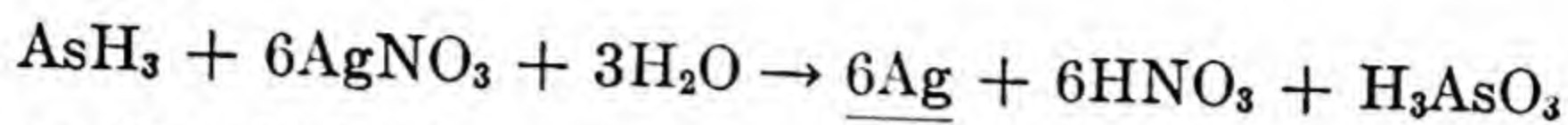
Ref., W. P. Skertchly: *J. Chem. Soc. (London)*, **94**, 36 (1908).

57



I-1193

Arsenious acid is formed when arsine is passed through a solution of silver nitrate.



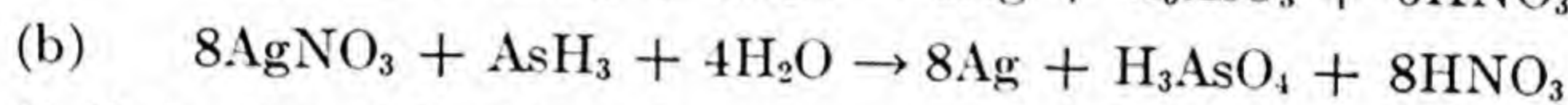
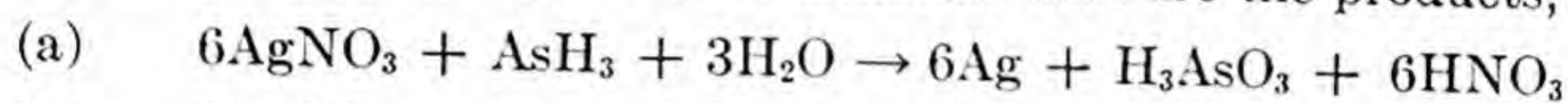
Preis, Ann. **257**, 199 (1890)

25



I-1194

By passing arsine gas through a water solution of silver nitrate, silver is deposited and arsenious acid produced (a); but if the solution of silver nitrate is ammoniacal, silver and arsenic acid are the products, (b).



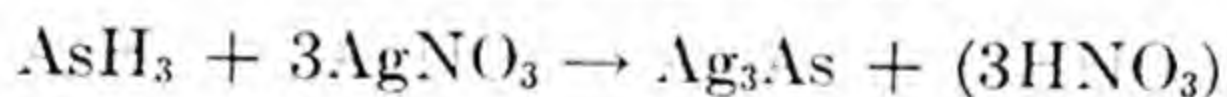
K. Preis, Ann., **257**, 178 (1890)

25



I-1195

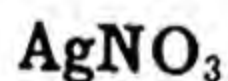
Silver arsenide is formed when a solution of a silver salt is dropped into an atmosphere of arsine in the absence of air.



Brukl, Z. anorg. Chem., **131**, 236 (1923)

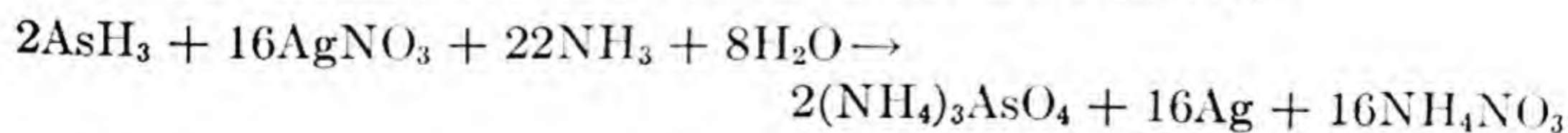
Ref., J. Chem. Soc. (London), **126**, 251 (1924)

25



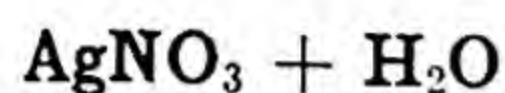
I-1196

Arsine is absorbed by 0.1N silver nitrate containing an excess of 15% ammonia. After absorption, the solution is heated on a water bath for four hours, during which time some ammonia is added to compensate for loss due to evaporation. Under these conditions, the following reaction is quantitative, between the limits of 90–101.5%:



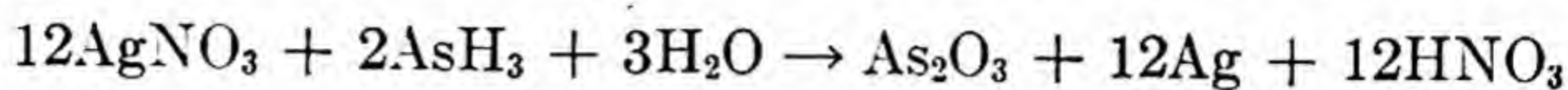
J. H. Křepelka and J. Fanta, Coll. Czech. Chem. Comm. **9**, 47 (1937)

87



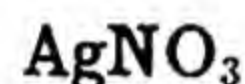
I-1197

Arsine may be absorbed quantitatively by silver nitrate, water and dilute hydrochloric acid to give arsenic trioxide, silver and nitric acid.



Carmelo Russo, *Gazz. Chim. Ital.* **34**¹, 197 (1904)

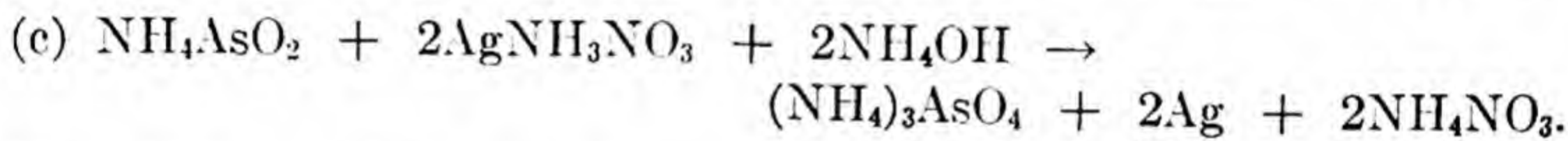
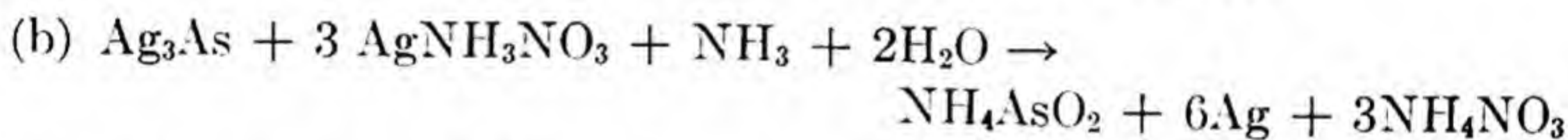
21



I-1198



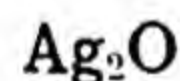
In dilute ammoniacal silver nitrate solution, arsine reacts according to the three equations:



H. Reckleben et al, *Z. anal. Chem.* **46**, 671 (1907)

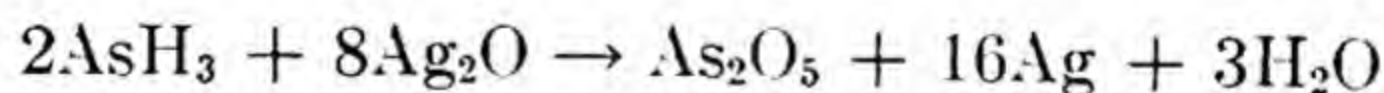
Ref.: W. P. Skertchly, *J. Chem. Soc. (London)*, **94**, 36 (1908)

57



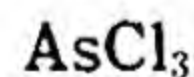
I-1199

Arsenic pentoxide and silver are formed when an ammoniacal solution of silver oxide oxidizes arsine.



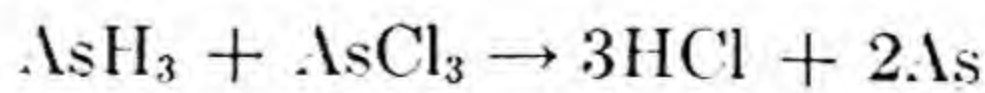
Reckleben, Lockemann and Eckardt: *Z. anal. Chem.* **46**, 671 (1907)

25



I-1200

Arsenic trichloride reacts with arsine at -50° forming arsenic.



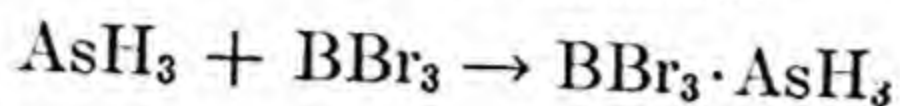
Stock: *Ber.* **34**, 949 (1901)

Ref., Tarible, *Compt. rend.* **132**, 207 (1901)

25

BBr₃**AsH₃****I-1201**

A double compound is formed when one allows arsine to react with a solution of boron bromide in carbon disulfide.

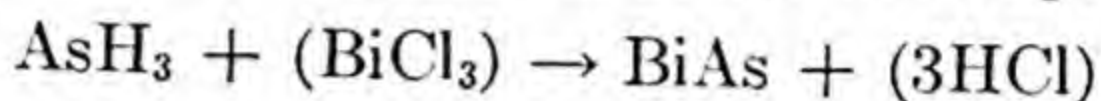


Stock: Ber. **34**, 949 (1901)

25

BiCl₃**AsH₃****I-1202**

Bismuth arsenide is formed when an acid aqueous solution of a bismuth salt is dropped into an atmosphere of arsine in complete absence of air.



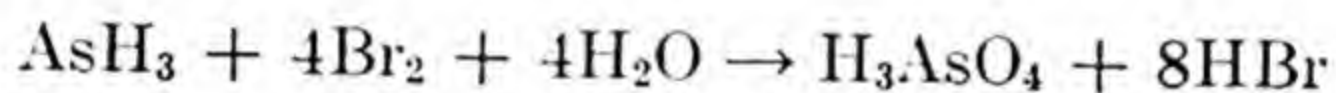
Brukl, Z. anorg. Chem., **131**, 236 (1923)

Ref., J. Chem. Soc. (London), **136**, 251 (1924)

1

Br₂**AsH₃****I-1203**

Arsine is oxidized to arsenic acid when allowed to react with a water solution of bromine.

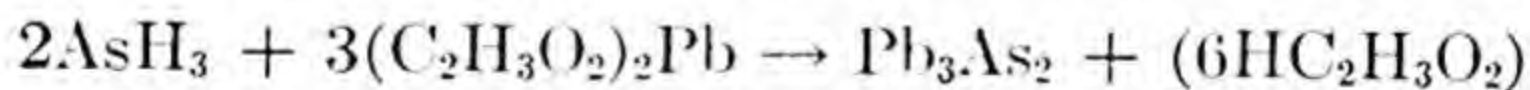


H. Reckleben and G. Lockemann: Z. anal. Chem. **47**, 105 (1908)

25

(C₂H₃O₂)₂Pb**AsH₃****I-1204**

Lead arsenide is formed when a neutral aqueous solution of lead acetate is dropped into an atmosphere of arsine in the complete absence of air.



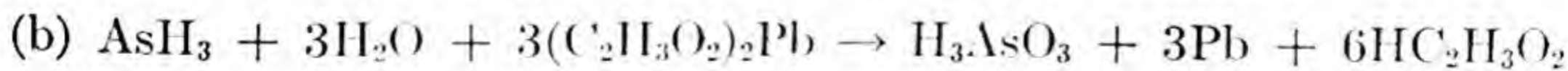
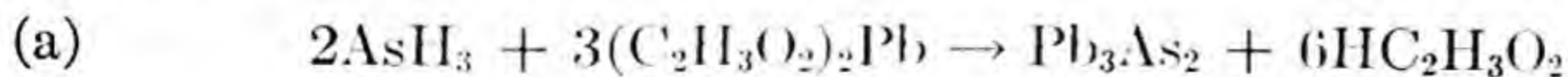
Brukl, Z. anorg. Chem., **131**, 236 (1923)

Ref., J. Chem. Soc. (London), **126**, 251 (1924)

1

(C₂H₃O₂)₂Pb**AsH₃****I-1205**

Arsenious acid and lead were formed when arsine reacted with a solution of lead acetate.



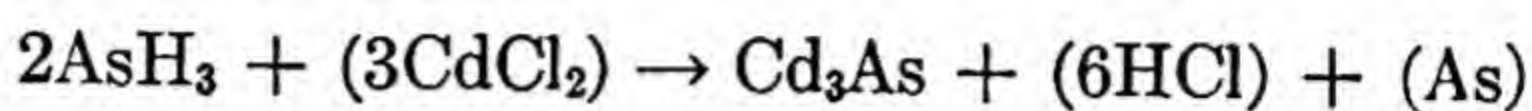
H. Reckleben, G. Lockemann and A. Eckardt, Z. anal. Chem., **46**, 671 (1907)

25



I-1206

Cadmium arsenide is formed when a weakly ammoniacal aqueous solution of cadmium chloride is dropped into an atmosphere of arsine in the complete absence of air.



Brukl, Zeit. anorg. Chem., **131**, 236 (1923)

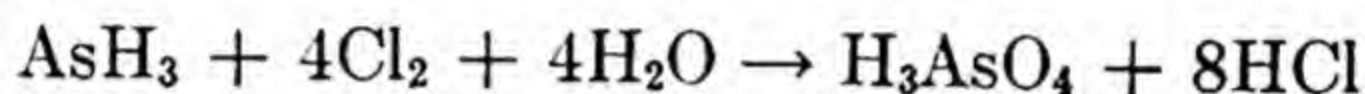
Ref., J. Chem. Soc. (London), **126**, 251 (1924)

1



I-1207

Arsine is oxidized to arsenic acid when allowed to react with a water solution of chlorine.



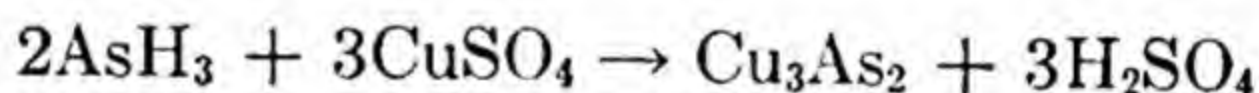
H. Reckleben and G. Lockemann: Z. anal. Chem. **47**, 105 (1908)

25



I-1208

A solution of cupric sulfate decomposes arsine with the formation of cupric arsenide.



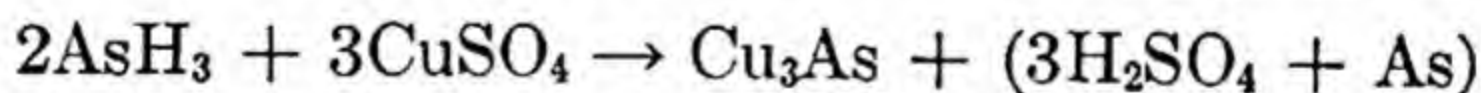
E. Soubeiran: Ann. chim. phys. [5] **20**, 20 (1880)

25



I-1209

Copper arsenide is formed when an aqueous solution of cupric sulfate is dropped into an atmosphere of arsine in complete absence of air.



Brukl, Z. anorg. Chem., **131**, 236 (1923)

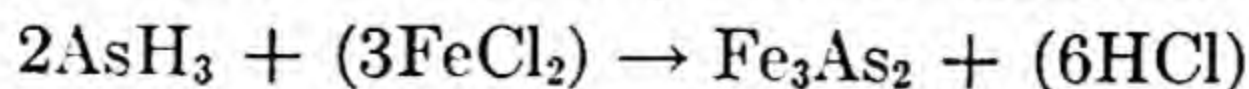
Ref., J. Chem. Soc. (London), **126**, 250 (1924)

1



I-1210

Iron arsenide is formed when an alkaline aqueous solution of ferric chloride is dropped into an atmosphere of arsine in absence of air.



Brukl, Z. anorg. Chem., **131**, 236 (1923)

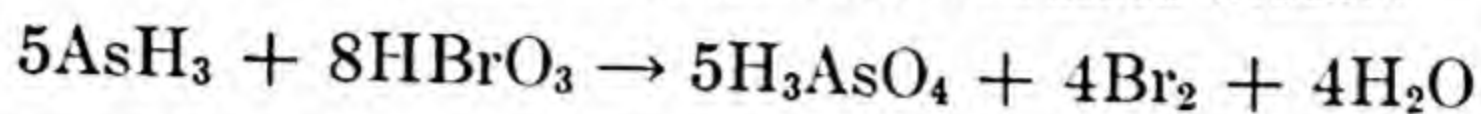
Ref., J. Chem. Soc. (London), **126**, 251 (1924)

25



I-1211

Arsenic acid is formed when bromic acid oxidizes arsine.



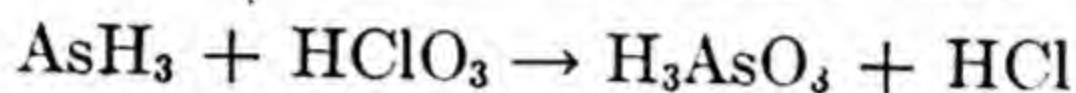
H. Reckleben and G. Lockemann: Z. anal. Chem. **47**, 105 (1908)

25



I-1212

Arsine is oxidized to arsenious acid by chloric acid.



Reckleben and Lockemann, Z. anal. Chem., **47**, 105 (1908)

28

Ref., Siliman, Am. J. Sci., [4], **14**, 285 (1902)

Ref., Z. anorg. Chem., **33**, 96 (1902)

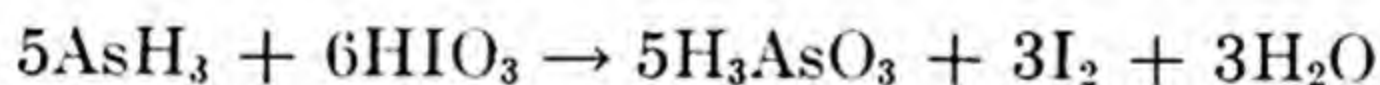
Ref., Z. anal. Chem., **47**, 105 (1908)

25



I-1213

Iodine and arsenious acid are formed when arsine reacts with iodic acid.



Parsons: Chem. News. **35**, 470 (1877)

25

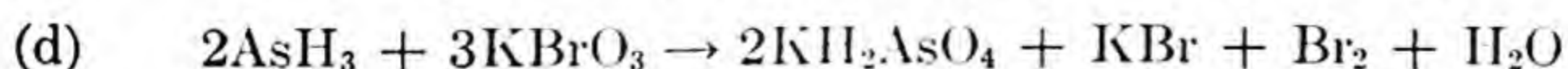
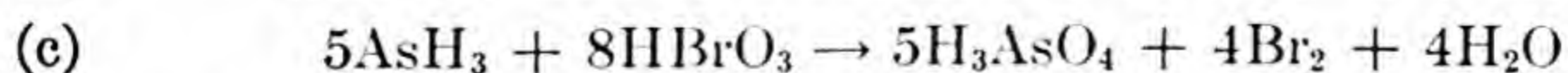
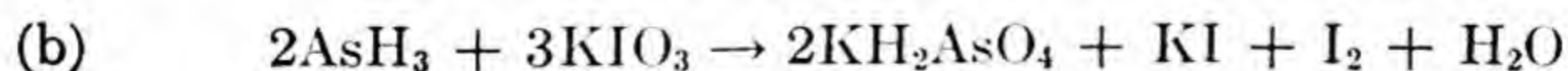
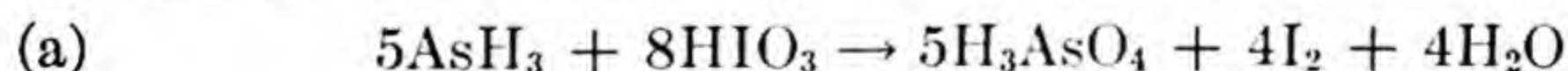
Ref., Z. Anal. Chem. **47**, 105 (1908)



I-1214

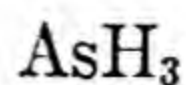


Arsine is oxidized to arsenic acid by iodic acid. The same type reaction occurs with potassium iodate, bromic acid and potassium bromate.



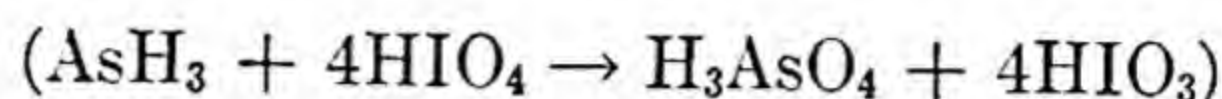
Reckleben and Lockemann, Z. anal. Chem. **47**, 105 (1908)

28



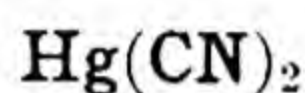
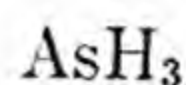
I-1215

Arsenic acid and iodic acid are formed when arsine is treated with an excess of periodic acid.



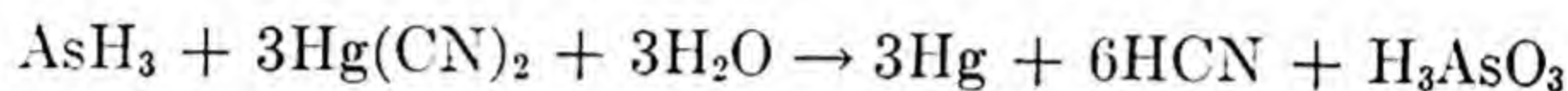
H. Reckleben and G. Lockemann: *Z. anal. Chem.*, **47**, 105 (1908)

25



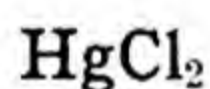
I-1216

Arsine was passed through a solution of mercuric cyanide. Mercury was thrown down and hydrocyanic acid set free.



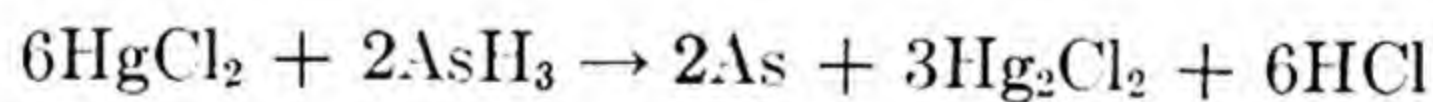
Robert Porrett, Jr., *Trans. Roy. Soc. (London)*, **104**, 545 (1814).

105



I-1217

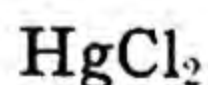
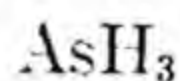
Arsine when passed over a strip of paper moistened with mercuric chloride solution deposits lemon yellow specks of free arsenic. Calomel and hydrochloric acid are formed at the same time. (Qualitative test for As)



Mayeneon and Bergeret,

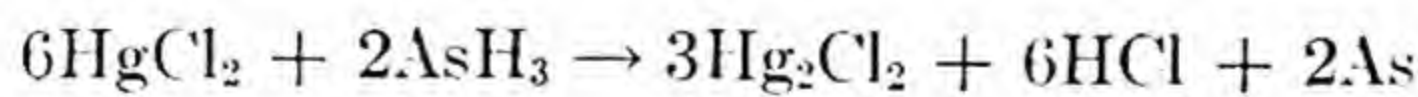
Ref., A., Henninger, *Ber.* **7**, 1444 (1874)

11



I-1218

Arsine reacts with mercuric chloride to form mercurous chloride, hydrochloric acid and arsenic; the reaction takes place in very dilute concentrations of arsine.



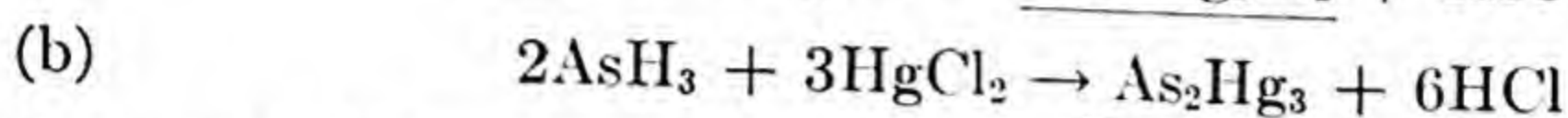
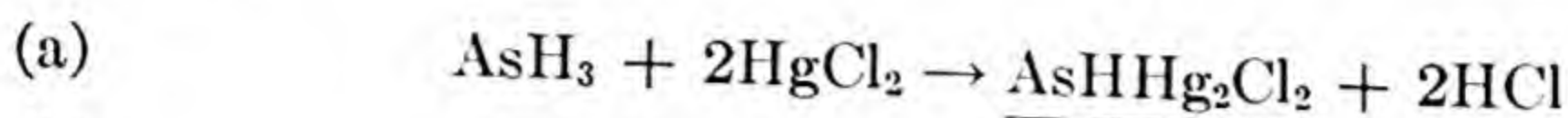
P. Carles, *Ann. Chim. Anal.* **21**, 116 (1916)

76



I-1219

A yellow precipitate forms when arsine reacts with mercuric chloride solution.



Franceschi: L'Orosi **13**, 289 (1890)

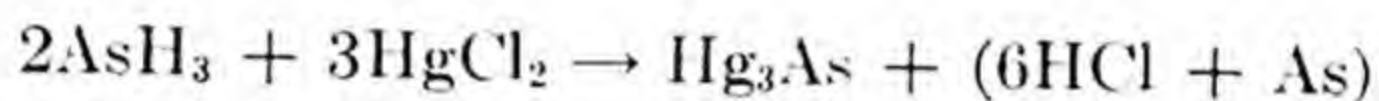
Ref.; Partheil and Amort, Ber. **31**, 594 (1898)

25



I-1220

Mercury arsenide is formed when an aqueous solution of mercuric chloride is dropped into an atmosphere of arsine in complete absence of air.



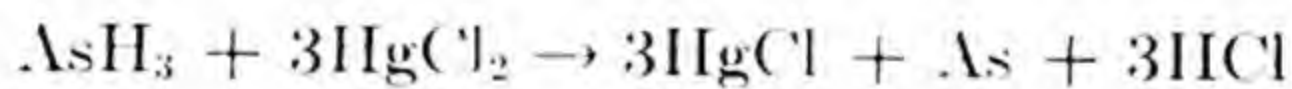
Brukl, Z. anorg. Chem., **131**, 236 (1923)

Ref., J. Chem. Soc. (London), **126**, 251 (1924)



I-1221

Arsine reacts with either an alcoholic or water solution of mercuric chloride with the formation of arsenic and mercurous chloride.



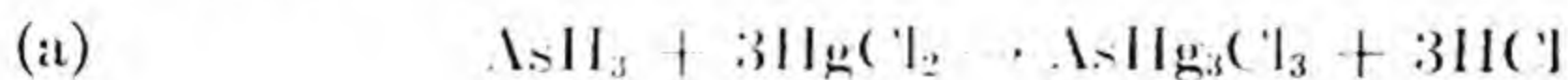
Lohmann, Pharm. Ztg. **36**, 748, 75 (1891)

25



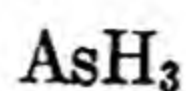
I-1222

Arsine reacts vigorously with a solution of mercuric chloride in excess with the formation of a yellow, brown or red precipitate.



Rose, Pogg. Ann. **51**, 423 (1840)

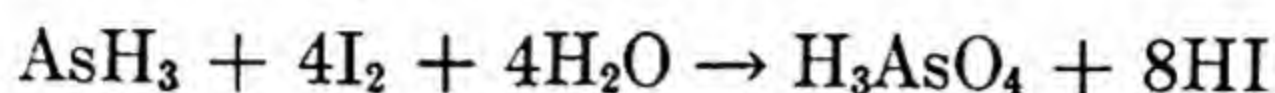
25



I

I-1223

Arsine is completely absorbed by a dilute (0.1 *N*) iodine solution, the arsenic being oxidized to pentavalent arsenic.



Wiley, Bewley and Irey, *Ind. Eng. Chem. Anal. Ed.*, **4**, 396 (1932)

33



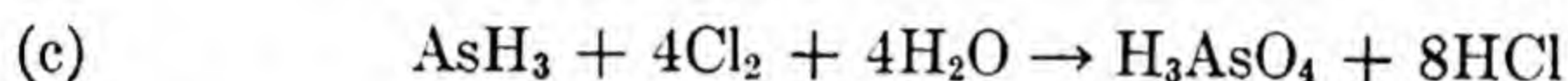
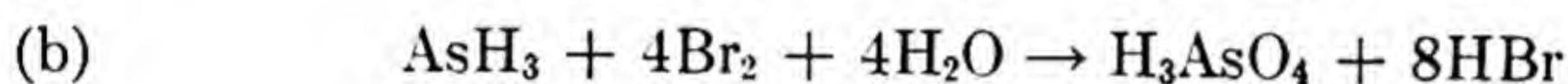
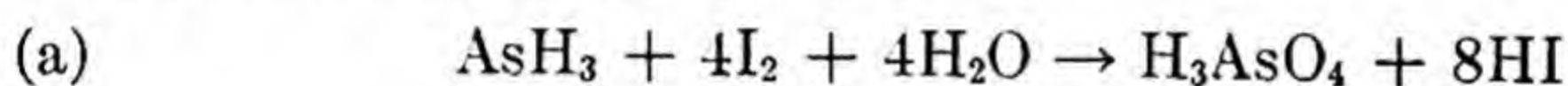
I

I-1224

Br

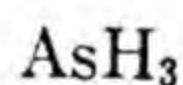
Cl

Arsine is oxidized to arsenic acid by iodine. The same type reaction occurs with bromine or chlorine.



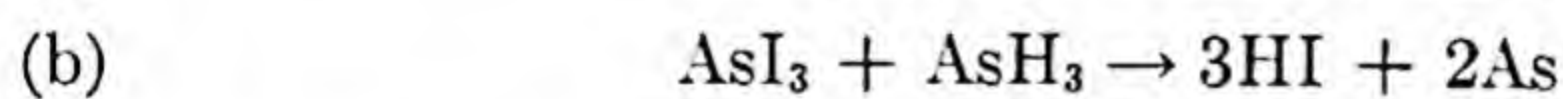
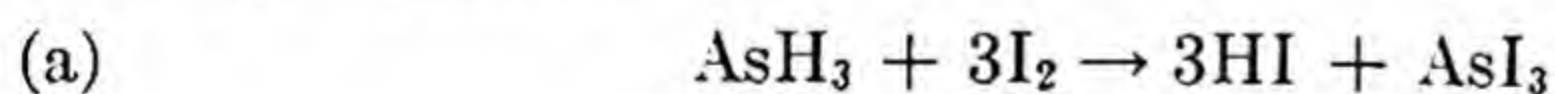
Reckleben and Lockemann, *Z. anal. Chem.*, **47**, 105 (1908)

28

I₂

I-1225

Under ordinary conditions arsine acts on dry iodine to give hydriodic acid and arsenic triiodide. With an excess of arsine the result is arsenic and hydriodic acid.



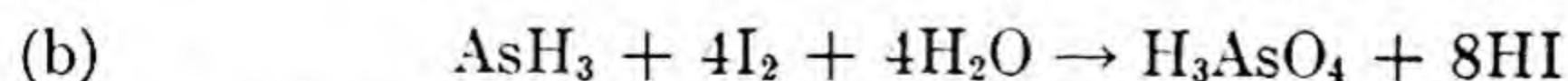
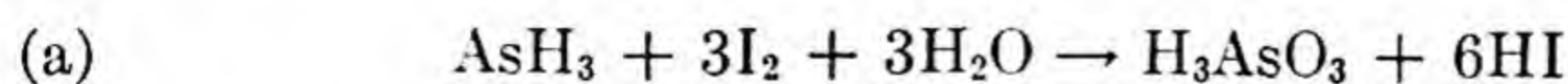
Carmelo Russo, *Gazz. chim. ital.*, **34**, 198 (1904)

21

I₂

I-1226

Arsine is oxidized by iodine to arsenious acid and finally to arsenic acid.



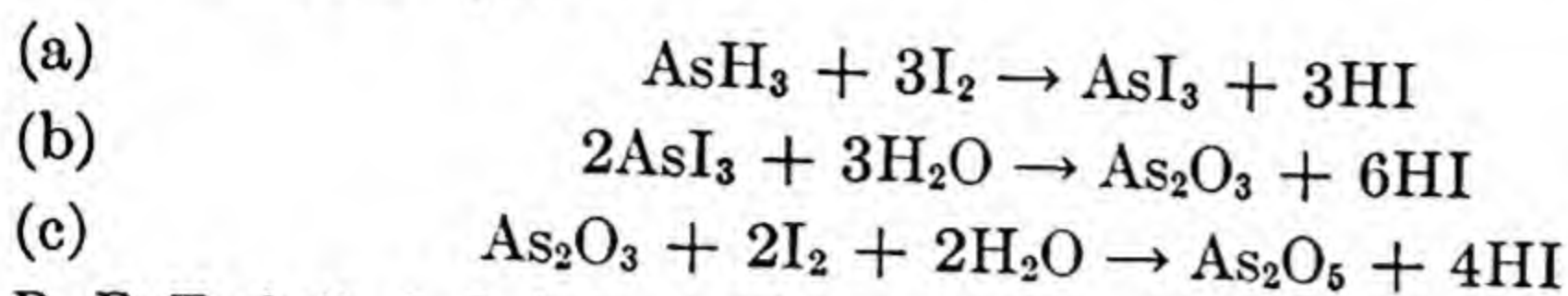
(a) H. Thomas and L. Hess, *Ber. Dtsch. Pharm. Ges.*, **30**, 483 (1921)

(b) H. Reckleben and G. Lockemann, *Z. anorg. Chem.*, **92**, 145 (1915)

25

I₂ + H₂OAsH₃**I-1227**

If arsine is passed through a gasoline solution of iodine, the following reaction takes place.

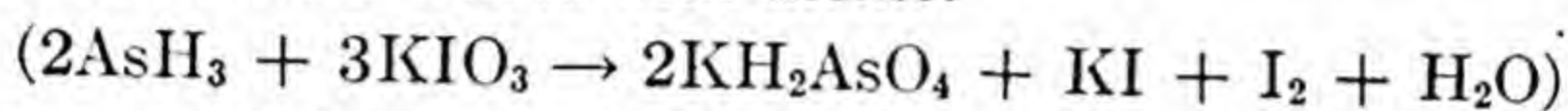


R. F. Tarbell, *J. Ind. Eng. Chem.*, **6**, 400 (1914)

22

AsH₃**KIO₃****I-1228**

Potassium dihydrogen arsenate and free iodine are formed when neutral potassium iodate reacts with arsine.

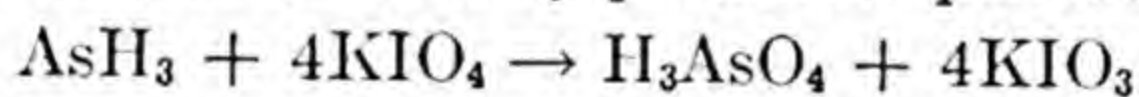


H. Reckleben and G. Lockemann, *Z. anal. Chem.*, **47**, 105 (1908)

25

AsH₃**KIO₄****I-1229**

Arsine is oxidized to arsenic acid by potassium periodate.

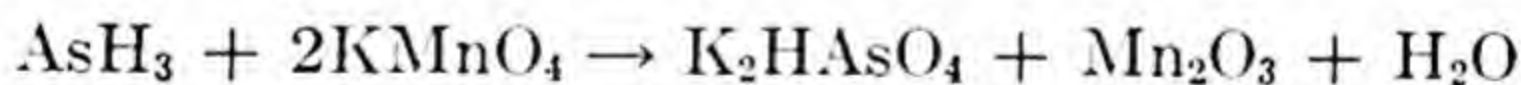


Reckleben and Lockemann, *Z. anal. Chem.* **47**, 105 (1908)

28

AsH₃**KMnO₄****I-1230**

Arsine reacts with potassium permanganate to give dipotassium hydrogen arsenate, manganic oxide and water.



D. Tivoli, *Gazz. Chim. Ital.*, **19**, 631 (1889)

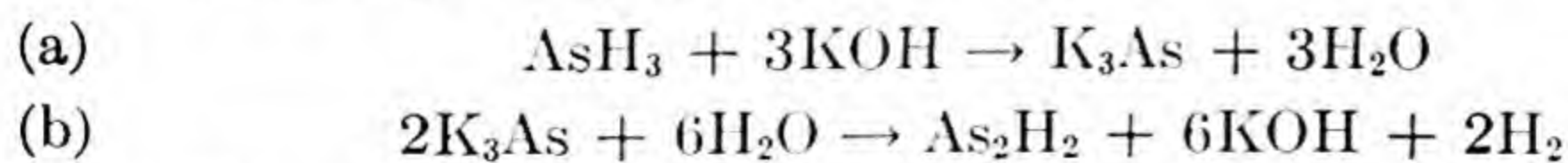
21

Ref., Jones, *J. Chem. Soc. (London)*, **33**, 98 (1878)

91

AsH₃**KOH****I-1231**

When arsine reacts with potassium hydroxide a solid potassium arsenide is formed, (a). This arsenide decomposes in the presence of water to form a solid arsenic hydride, (b). The same type reactions occur when sodium hydroxide is used.

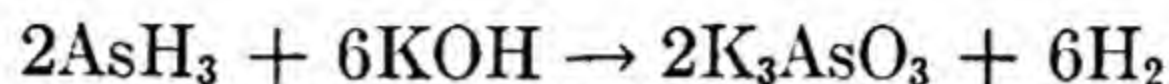


H. Reckleben and J. Scheiber, *Z. anorg. Chem.*, **70**, 255 (1911)

25

**KOH****I-1232**

Potassium arsenite is formed when arsine reacts with heated dry potassium hydroxide.

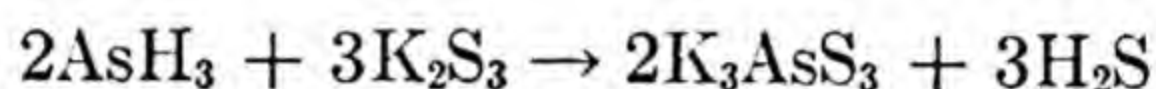


O. Frhr. v. d. Pfordten, Ber. **17**, 2897 (1884)

25

**K₂S₃****I-1233**

Potassium thioarsenite may be formed when arsine reacts with potassium trisulfide.

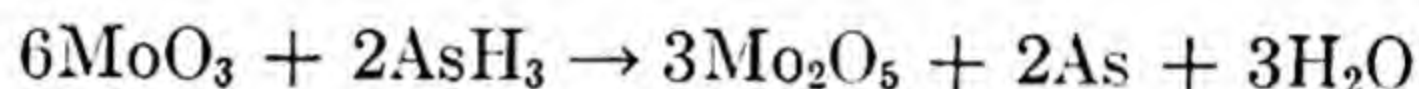


O. Frhr v. d. Pfordten, Ber., **17**, 2897 (1884)

25

**MoO₃****I-1234**

A purple oxide is produced when molybdenum trioxide is heated gently with arsine.

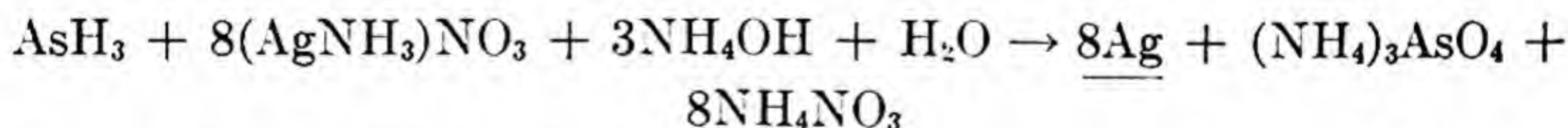


C. H. Ehrenfeld, J. Am. Chem. Soc., **17**, 391 (1895)

1

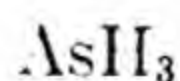
**NH₄OH****I-1235****(AgNH₃)NO₃**

An ammoniacal solution of silver nitrate reacts with arsine when boiled, producing silver and ammonium arsenate.

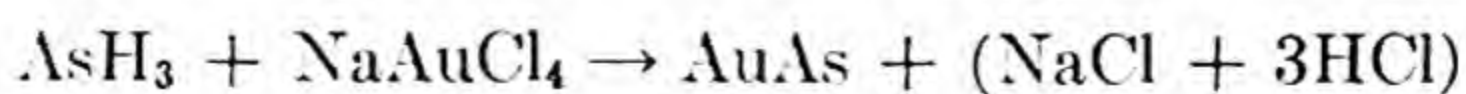


H. Reckleben, G. Lockemann and A. Eckardt, Z. anal. Chem. **46**, 671 (1907)

25

**NaAuCl₄****I-1236**

Gold arsenide is formed when a solution of sodium aurichloride is dropped into an atmosphere of arsine in complete absence of air.



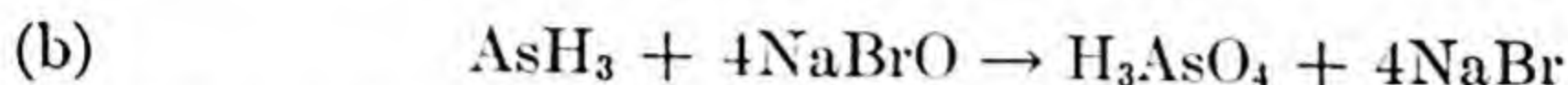
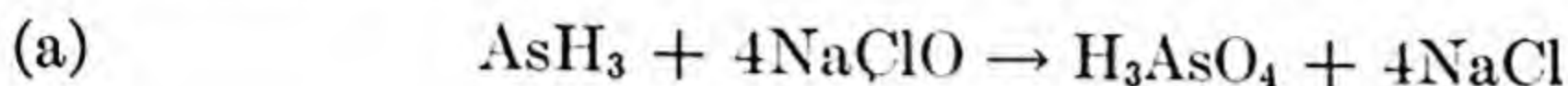
Brükl, Z. anorg. Chem., **131**, 236 (1923)

Ref., J. Chem. Soc. (London), **126**, 251 (1924)

25

**NaClO****I-1237****NaBrO**

Arsine is oxidized to arsenic acid by sodium hypochlorite. The same type reaction occurs with sodium hypobromite.

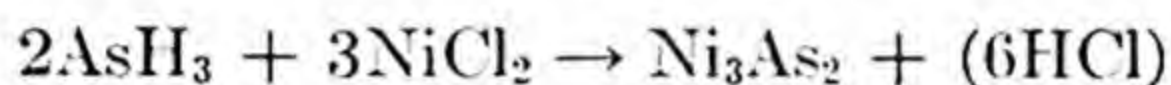


Reckleben and Lockemann, *Z. anal. Chem.* **47**, 105 (1908)

28

**NiCl₂****I-1238**

Nickel arsenide is formed when an ammoniacal solution of nickel chloride is dropped into an atmosphere of arsine in absence of air.



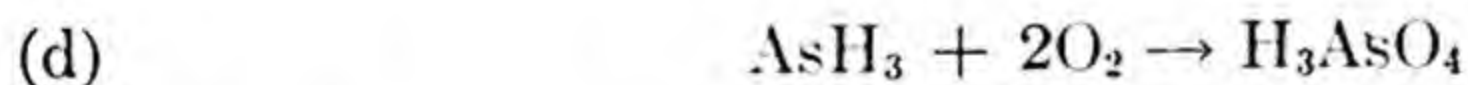
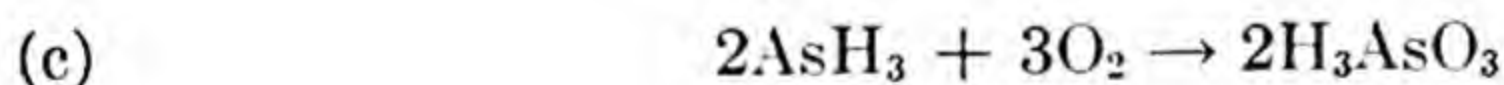
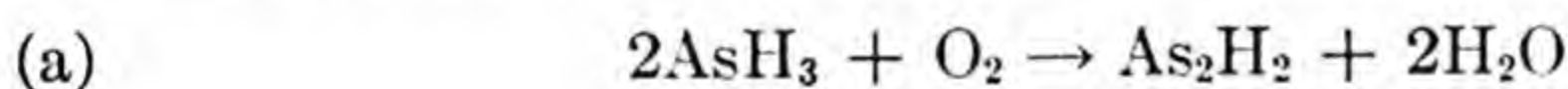
Brukl, *Z. anorg. Chem.*, **131**, 236 (1923)

Ref., *J. Chem. Soc. (London)*, **126**, 251 (1924)

25

**O₂****I-1239**

Arsenic acid is the final product obtained when arsine is oxidized.

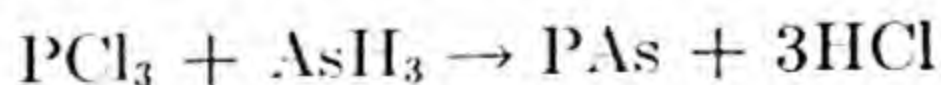


Reckleben, *Z. anorg. Chem.*, **92**, 147 (1915)

25

**PCl₃****I-1240**

Arsine when passed into phosphorus trichloride (below 20°C) forms phosphorus arsenide and hydrogen chloride.



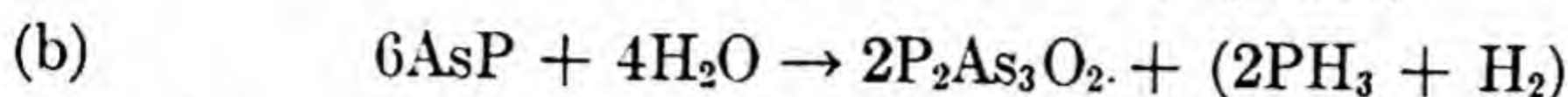
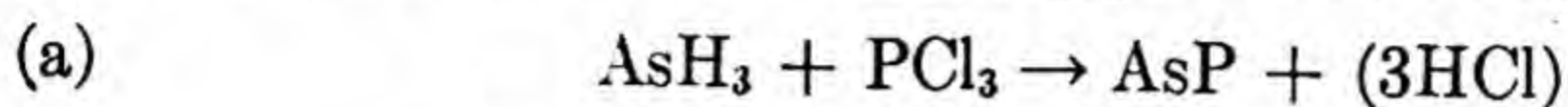
Jac. V. Janowsky, *Ber.*, **6**, 216 (1873)

11



I-1241

A phosphorus arsenic oxide is formed when arsine reacts with phosphorus trichloride and the resulting product is treated with water.



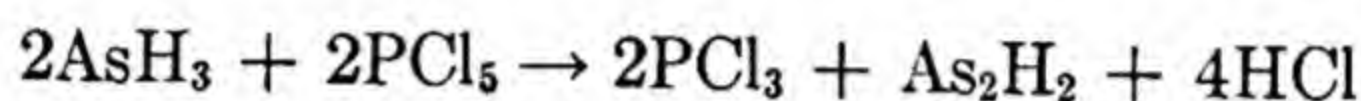
Janowsky, Ber., **6**, 662 (1873)

25



I-1242

A solid hydride is formed when arsine reacts with phosphorus pentachloride.



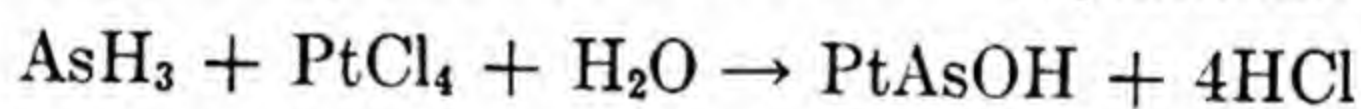
Janowsky: Ber., **8**, 1638 (1875)

25



I-1243

A black precipitate of platinum arsenic hydroxide is formed when a rapid stream of pure arsine is passed into a solution of platinum tetrachloride.



D. Trivoli, Gazz. Chim. Ital., **14**, 487-491 (1884)

Ref., Ber., **18**, 137 (1885)

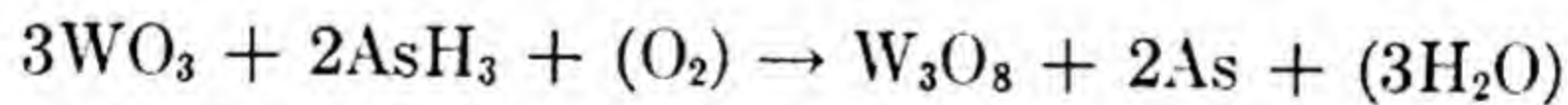
21

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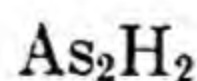
I-1244

A blue oxide of tungsten was produced when tungsten trioxide was reduced by arsine at 125-150°.



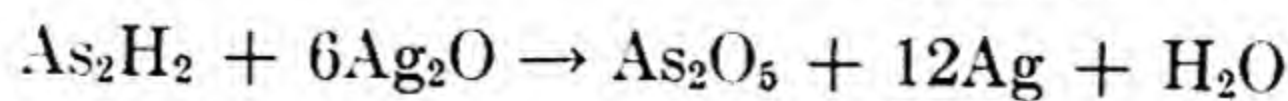
C. H. Ehrenfeld, J. Am. Chem. Soc., **17**, 389 (1895)

1



I-1245

Arsenic pentoxide and silver are formed when an ammoniacal solution of silver oxide is reduced by solid arsenic hydride.



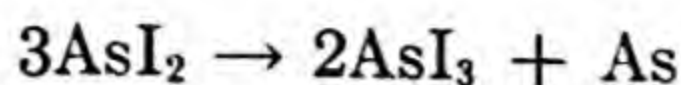
Reckleben and Scheiber: Z. anorg. Chem., **70**, 255 (1911)

25

(H₂O)

I-1246

When arsenic diiodide is decomposed by water, arsenic triiodide and arsenic are formed.



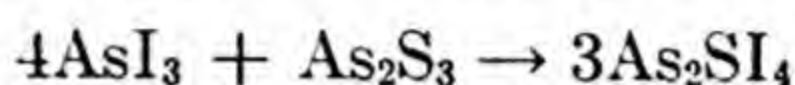
J. T. Hewitt and T. W. Winmill, *J. Chem. Soc. (London)*, **91**, 963 (1907)

102

As₂S₃

I-1247

Crystalline needles are obtained when arsenic trisulfide is melted with an excess of arsenic triiodide in the absence of air.



L. Ouvrard: *Compt. rend.*, **117**, 107

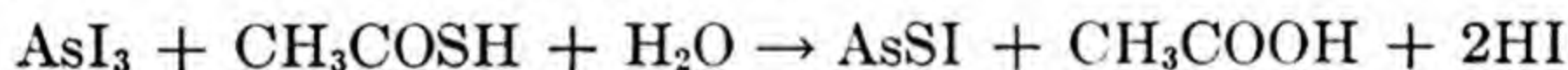
Ref., *Ber.*, **26**, 672 (1893)

25

CH₃COSH + H₂O

I-1248

If dry arsenic triiodide is heated with thioacetic acid and water, arsenic thioiodide, acetic acid, and hydriodic acid are formed.



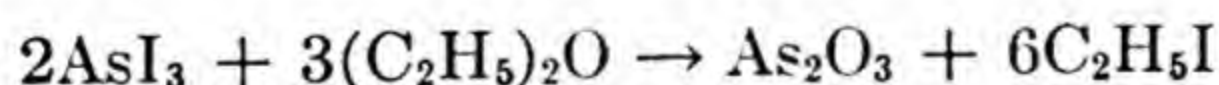
N. Tarugi: *Gazz. Chim. Ital.* **27**², 155 (1897)

21

(C₂H₅)₂O

I-1249

When arsenic triiodide is dissolved in ether, the yellow color fades after a few hours. The absorption spectrum indicates that ethyl iodide is formed.



C. B. Allsopp, *Proc. Roy. Soc. (London)* **158A**, 171 (1937)

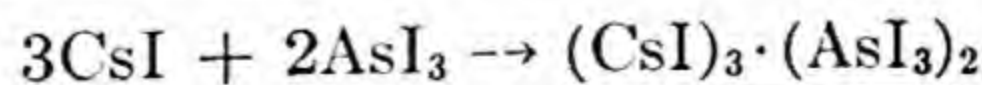
110



CsI

I-1250

A deep red precipitate is formed when a solution of cesium iodide in hydriodic acid reacts with arsenic triiodide at boiling temperature.



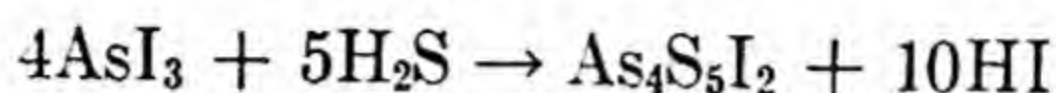
H. L. Wheeler, *Z. anorg. Chem.*, **4**, 451 (1893)

28

AsI_3

H₂S **I-1251**

An arsenic diiodosulfide is formed when a current of hydrogen sulfide is passed over arsenic triiodide heated to 200°.



L. Ouvrard, *Compt. rend.*, **117**, 107

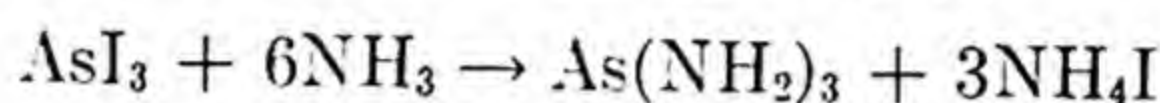
Ref., *Ber.*, **26**, 672 (1893)

25

AsI_3

NH₃ **I-1252**

Arsenamide is formed along with ammonium iodide when ammonia reacts with arsenic triiodide at -30° to -40°C.



Hugot, *Compt. Rend.*, **139**, 54 (1904)

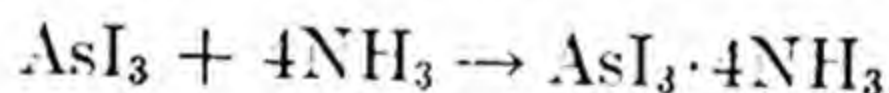
Ref., *J. Chem. Soc. (London)*, **86**, 559 (1904)

1

AsI_3

NH₃ **I-1253**

A white compound forms when arsenic triiodide is volatilized in an atmosphere of ammonia and allowed to stand over sulfuric acid.



Besson: *Compt. rend.*, **110**, 1258

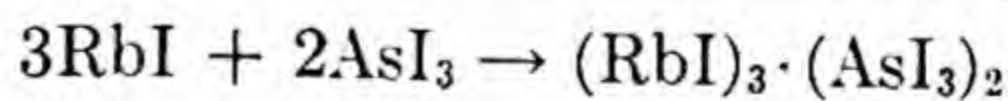
Ref., *Ber.*, **23**, 549 (1890)

25

AsI_3

RbI **I-1254**

A deep red precipitate is formed when a solution of rubidium iodide in hydriodic acid reacts with arsenic triiodide at boiling temperature.



H. L. Wheeler, *Z. anorg. Chem.*, **4**, 451 (1893)

28

AsI_3

S **I-1255**

Arsenic trisulfide and iodine vapor are formed when arsenic triiodide is heated with sulfur.



R. Schneider, *J. prakt. Chem.*, **36**, 498

Ref., *Ber.*, **21**, 169 (1888)

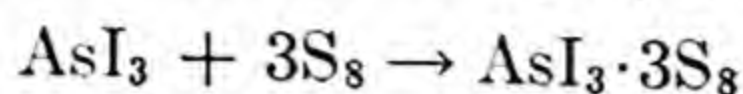
25



S

I-1256

Sulfur forms addition compounds with arsenic triiodide, when the reactants are mixed in the stoichiometrical proportions in carbon disulfide.



Kleinboldt and Schneider, *J. prakt. Chem.*, **120**, 238 (1929)

Ref., Hertl, *Z. physik. Chem.*, **15B**, 51 (1931)

Ref., C. B. Allsopp, *Proc. Roy. Soc. (London)*, **158A**, 176 (1937)

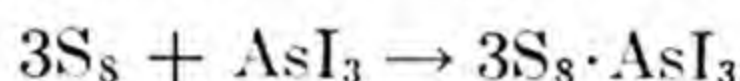
110



S

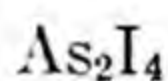
I-1257

Sulfur and arsenic triiodide are dissolved in carbon disulfide, using approximately 5% excess of sulfur, to form long prisms, or tablets of the orange addition compound, melting at 105°.



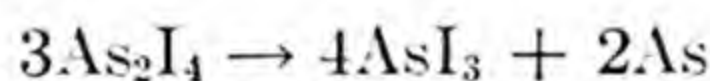
V. Auger, *Compt. rend.*, **146**, 478-9 (1908)

38

(H₂O)

I-1258

Arsenic diiodide decomposes in the presence of water to yield arsenic triiodine and free arsenic.



Hewett and Winmill, *J. Chem. Soc. (London)*, **91**, 963 (1907)

103

H₂O

I-1259

Arsenamide is decomposed by water with the formation of arsenic trioxide and ammonia.



Hugot, *Compt. rend.* **139**, 54 (1904)

Ref., *J. Chem. Soc. (London)*, **86**, 559 (1904)

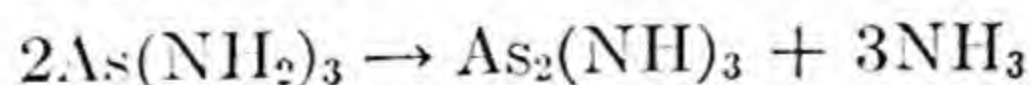
25



Δ

I-1260

Arsenamide decomposes when the temperature rises above 0 degrees, the decomposition being complete at 60°, and arsenimide is formed.



Hugot, *Compt. rend.*, **139**, 54 (1904)

Ref., *J. Chem. Soc. (London)*, **86**, 559 (1904)

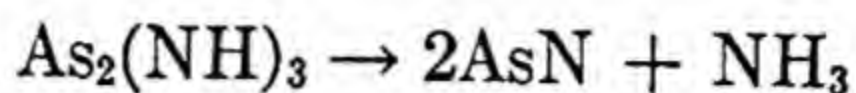
1



Δ

I-1261

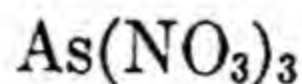
When heated to 250° arsenimide is decomposed into arsenic nitride and ammonia.



Hugot, Compt. rend., **139**, 54 (1904)

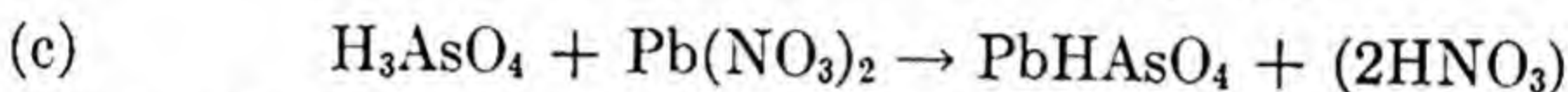
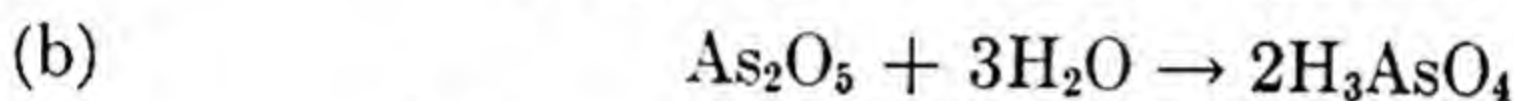
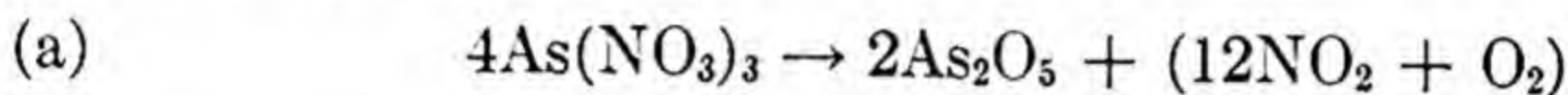
Ref., J. Chem. Soc. (London), **86**, 559 (1904)

25

**Pb(NO₃)₂**

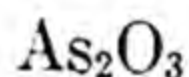
I-1262

Lead nitrate precipitates lead hydrogen arsenate from a solution of arsenic nitrate.



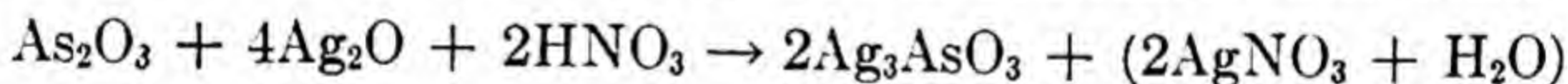
William Gregor, Trans. Roy. Soc. (London), **99**, 204 (1809)

105

**Ag₂O**

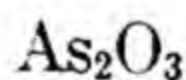
I-1263

A yellow crystalline precipitate of silver arsenite is formed when silver oxide is treated with a solution of arsenic trioxide in ammonia and heated to 100° and the resulting solution neutralized with nitric acid.



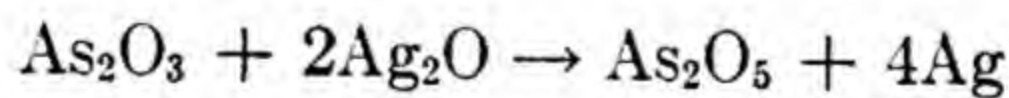
Reichard: Ber., **30**, 1913 (1897)

25

**Ag₂O**

I-1264

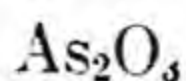
Arsenic trioxide reduces an ammoniacal solution of silver oxide to metallic silver when boiled.



L. Mayer: J. prakt. Chem. N. F. **22**, 103

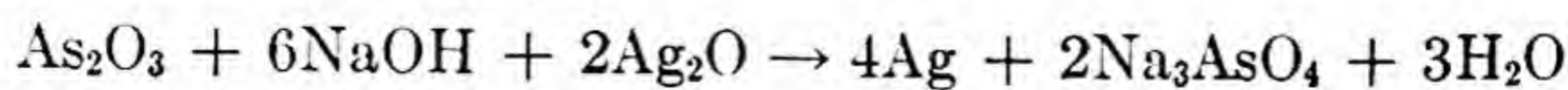
Ref., Ber., **13**, 1754 (1880)

25

**Ag₂O + NaOH**

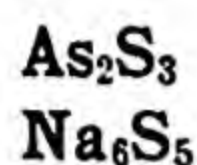
I-1265

Silver precipitates when a solution of arsenic trioxide in sodium hydroxide reacts with silver oxide.



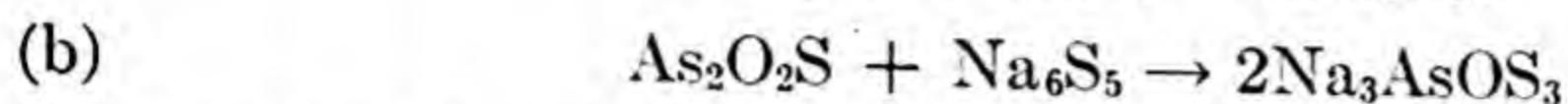
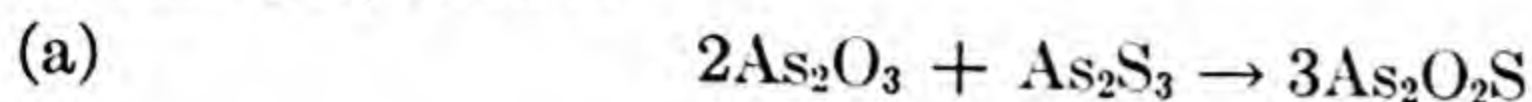
Reichard: Ber., **30**, 1913 (1897)

25



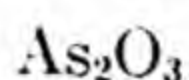
I-1266

Sodium trithioxy arsenate can be obtained by treating the product resulting from melting arsenic trioxide with arsenic trisulfide, with sodium polysulfide.



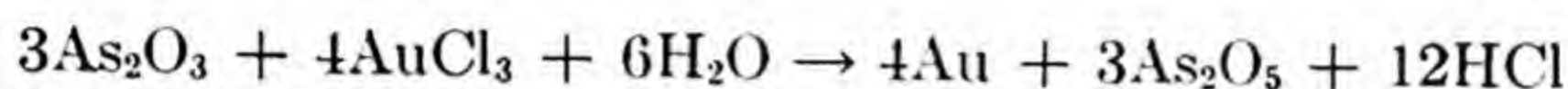
Weinland and Rumpf: Ber., **29**, 1008 (1896)

25



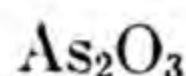
I-1267

Auric chloride is reduced to gold when treated with arsenic trioxide and water.



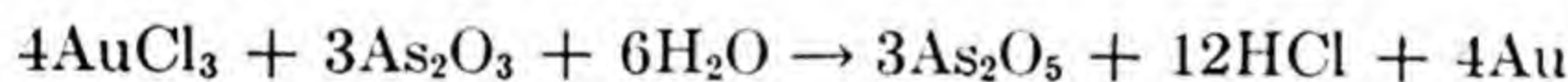
Rupp: Ber., **35**, 2011 (1902)

25



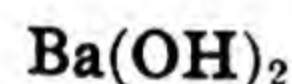
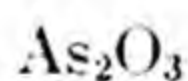
I-1268

Metallic gold may be precipitated from a hot auric chloride solution with an excess of arsenic trioxide.



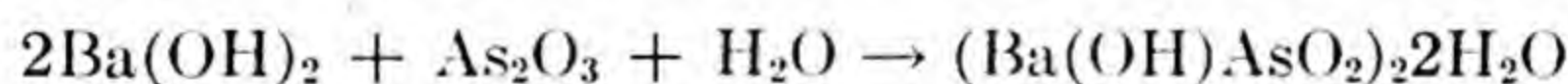
Victor E. Herschlag, Ind. Eng. Chem., Anal. Ed., **13**, 561 (1941)

44



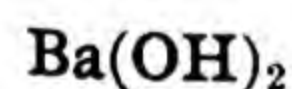
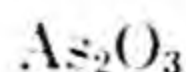
I-1269

Hydrated basic barium metarsenite is formed when a solution of barium hydroxide and a solution of arsenic trioxide are mixed.



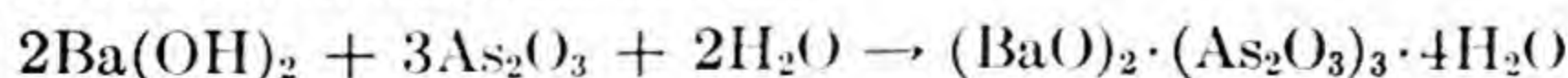
Story and Anderson, J. Am. Chem. Soc., **46**, 537 (1924)

1



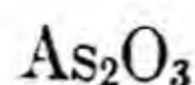
I-1270

Tetrahydrated barium metarsenite is formed when a solution of barium hydroxide reacts with a solution of arsenic trioxide containing 0.6 g. per 100 cc. of solution at 25°.



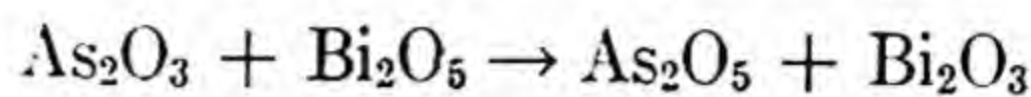
Story and Anderson, J. Am. Chem. Soc., **46**, 537 (1924)

1



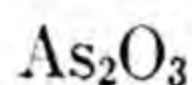
I-1271

Arsenic pentoxide is formed when a solution of arsenic trioxide in sodium hydroxide reacts with bismuth pentoxide.



Reichard: Ber. **30**, 1913 (1894)

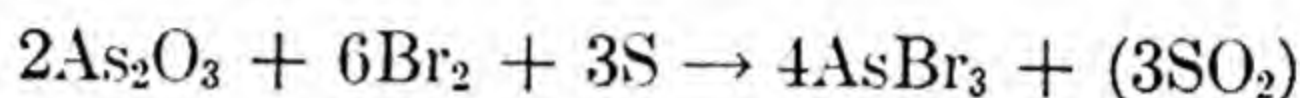
25



I-1272



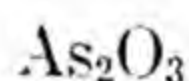
Arsenic tribromide is formed when a mixture of arsenic trioxide, bromine and sulfur is heated.



Oddo and Giachery, Gazz. Chim. Ital., **53**, 56 (1923)

Ref., J. Chem. Soc., (London), **124**, 316 (1923)

25



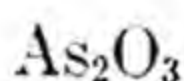
I-1273

If dry sodium acetate is mixed with arsenic trioxide in a hard glass test tube and heated to a high temperature, a garlic like odor is produced.



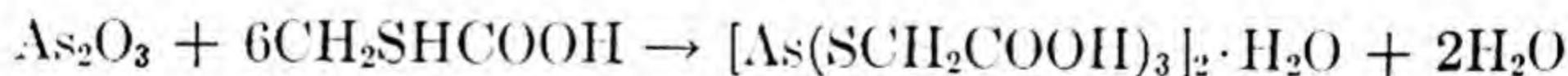
S. J. Thomas, J. Ind. Eng. Chem., **8**, 822 (1916)

22



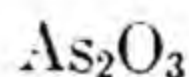
I-1274

Colorless crystals are obtained when a solution of arsenic trioxide in thioglycolic acid is cooled.



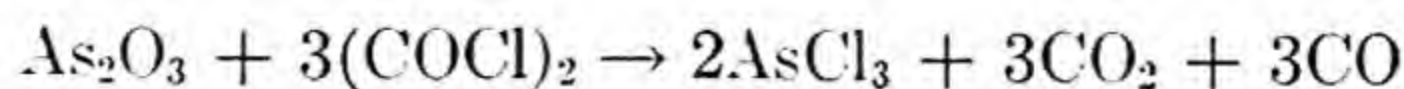
A. Rosenheim and I. Davidsohn, Z. anorg. Chem. **41**, 231 (1904)

28



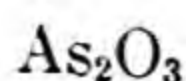
I-1275

Arsenic trioxide is converted into the chloride by refluxing with a slight excess of oxalyl chloride.



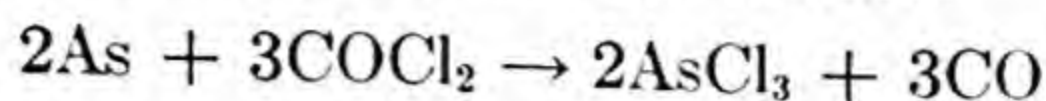
Roger, Adams and L. H. Ulick, J. Am. Chem. Soc., **42**, 602 (1920)

1



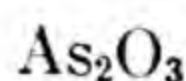
I-1276

When arsenic is heated in an atmosphere of carbonyl chloride, the chloride of arsenic and carbon monoxide are formed.



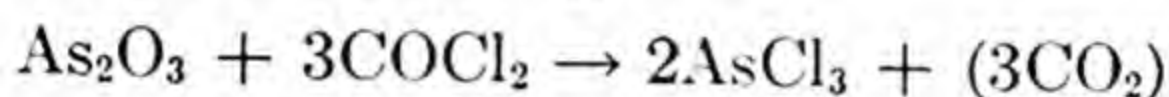
J. Davy, *Phil. Trans.*, **102**, 144 (1812)

44



I-1277

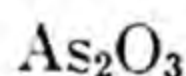
A quantitative yield of arsenic trichloride is obtained when phosgene is passed over a mixture of arsenic trioxide (80 percent) and phosgene (20 percent) heated at 200–260 degrees.



Milligan, Baude and Boyd, *J. Ind. Eng. Chem.*, **12**, 221 (1920)

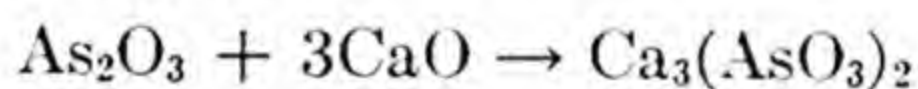
Ref., *J. Chem. Soc. (London)*, **118**, 372 (1920)

25



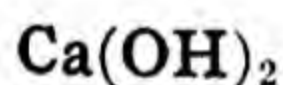
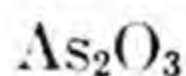
I-1278

Calcium arsenite is formed when a mixture of arsenic trioxide and calcium oxide is heated to 300°.



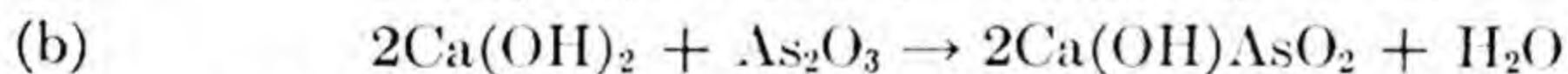
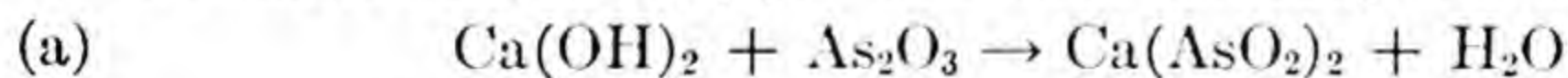
Kalsing: *Z. anorg. Chem.*, **149**, 68 (1925)

25



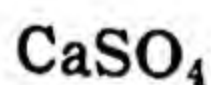
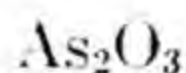
I-1279

Calcium metarsenite is formed when a solution of calcium hydroxide and a solution of arsenic trioxide containing .06 g. per 100 cc. water at 25° are shaken together, (a). The basic salt may also be formed, (b).



Story and Anderson, *J. Am. Chem. Soc.*, **46**, 536 (1924)

25



I-1280

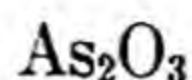
A crystalline compound is obtained when calcium sulfate and arsenic trioxide are dissolved in sulfuric acid and heated to drive off sulfuric acid.



Kühl, *Arch. Pharm.*, **245**, 377 (1907)

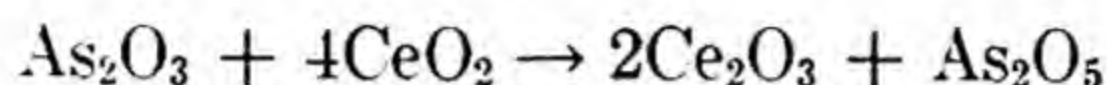
Ref., *J. Chem. Soc. (London)*, **94**, 36 (1908)

25



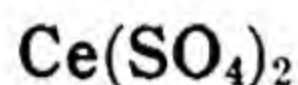
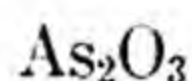
I-1281

Cerium oxide oxidizes arsenic trioxide when heated.



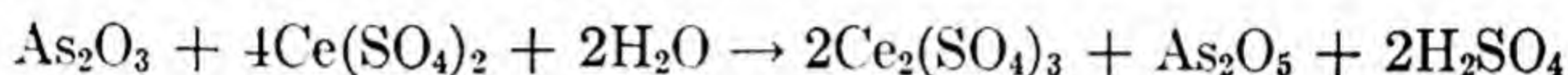
Kalsing, Z. anorg. Chem., **149**, 68 (1925)

25



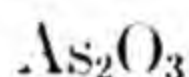
I-1282

Arsenic trioxide is oxidized when a strong acid solution of arsenic trioxide reacts with ceric sulfate at 70°.



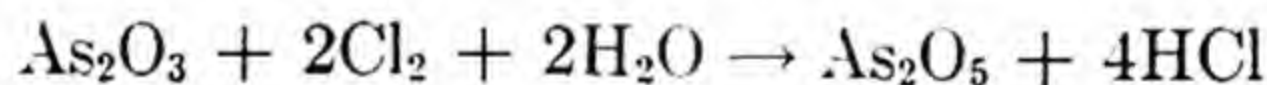
Atanasiu and Stefanescu, Ber., **61**, 1343 (1928)

25



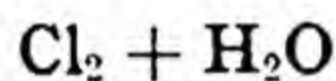
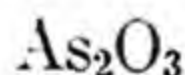
I-1283

Arsenic trioxide reacts with chlorine in the presence of water to form arsenic pentoxide and hydrochloric acid.



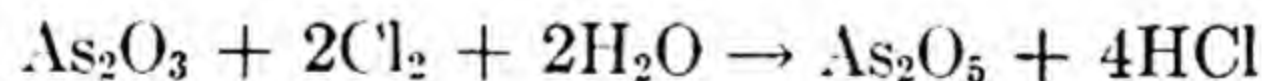
R. L. Taylor, J. Chem. Soc., (London), **97**, Pt. 2, 2541 (1910)

103



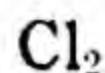
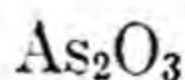
I-1284

Arsenic trioxide, chlorine and water heated together will produce arsenic pentoxide and hydrochloric acid.



M. G. Levi and V. Bettoni, Gazz. chim. ital. **35**¹, 331 (1905)

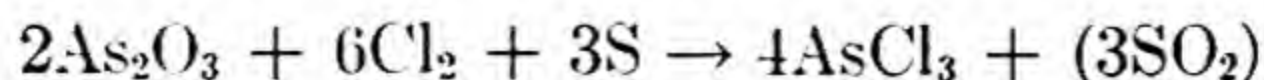
21



I-1285



Arsenic trichloride is prepared when chlorine is passed through a heated mixture of powdered sulfur and arsenic trioxide.



Oddo and Giachery, Gazz. Chim. Ital., **53**, 56 (1923)

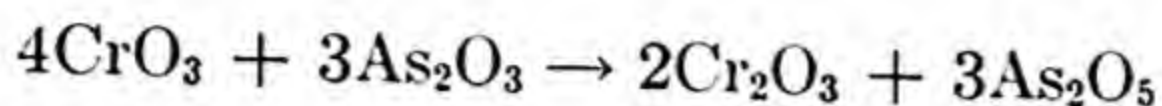
Ref., J. Chem. Soc. (London), **124**, 316 (1923)

25



I-1286

The oxidation of arsenic trioxide with chromium trioxide is represented by the following equation:



Rodolfo Namias, *Gazz. chim. ital.* **22**¹, 511 (1892)

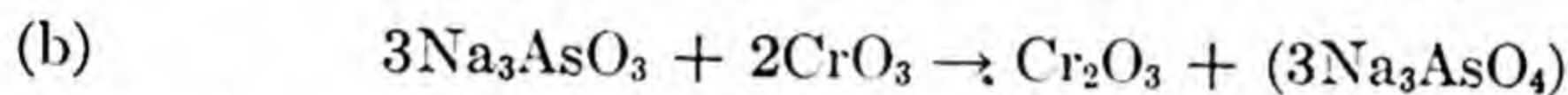
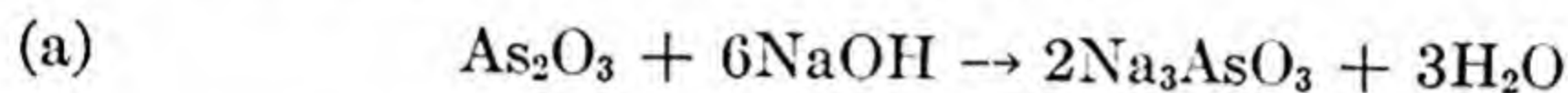
21



I-1287

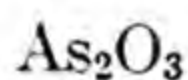


Chromic oxide is formed when a solution of arsenic trioxide in sodium hydroxide reacts with chromium trioxide.



Reichard, *Ber.*, **30**, 1913 (1897)

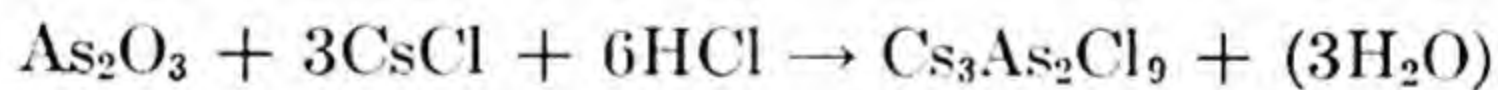
25



I-1288

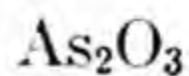


Cesium arsenic chloride is obtained when solutions of cesium chloride and arsenic trioxide dissolved in dilute hydroxychloric acid are mixed.



Wheeler, *Z. anorg. Chem.*, **4**, 451 (1893)

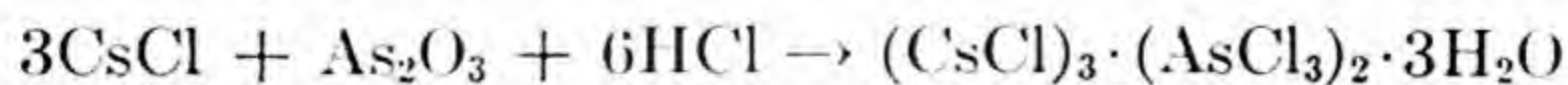
25



I-1289



Yellow crystals are obtained when cesium chloride reacts with a solution of arsenic trioxide in hydrochloric acid.

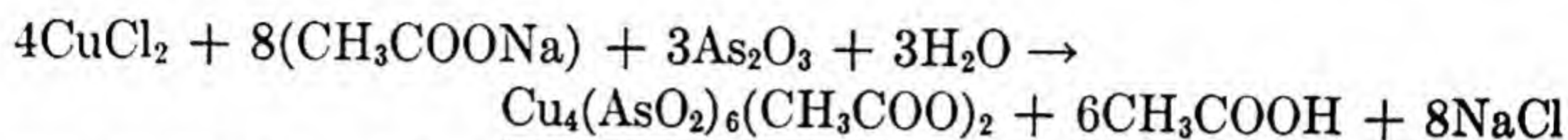


H. L. Wheeler, *Z. anorg. Chem.*, **4**, 451 (1893)

28

CuCl₂
C₂H₃O₂Na
As₂O₃
I-1290

Starting with a solution containing cupric chloride, sodium acetate, and arsenic trioxide, the following reaction takes place on evaporation of the solution, producing a precipitate of Paris green as the acetic acid evaporates off.

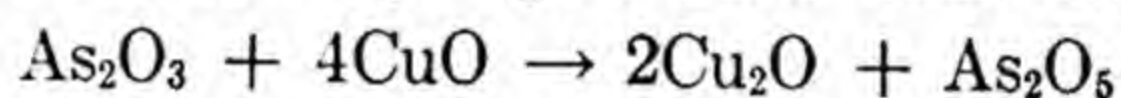


Curtin, Ind. Eng. Chem., **19**, 994 (1927)

24

CuO
As₂O₃
I-1291

Arsenic trioxide is oxidized by cupric oxide when heated to 400°.

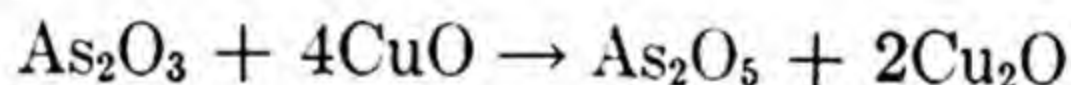


Kalsing, Z. anorg. Chem., **149**, 68 (1925)

25

CuO
As₂O₃
I-1292

Arsenic trioxide may be changed to arsenic pentoxide by its reaction with cupric oxide.

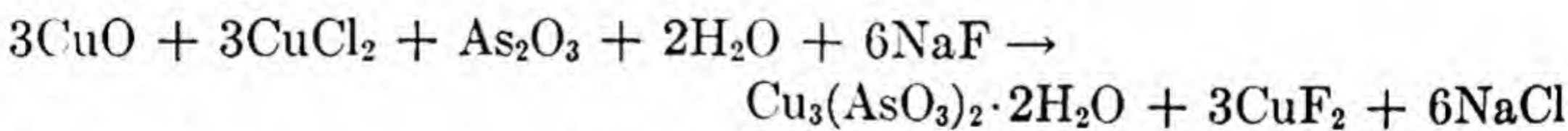


M. Terreil, Chem. News, **6**, 301 (1862)

101

CuO + CuCl₂ + NaF
As₂O₃
I-1293

When cupric oxide, cupric chloride, arsenic trioxide, water and sodium fluoride react together, cupric fluoride and sodium chloride are produced, and cupric orthoarsenite is precipitated.

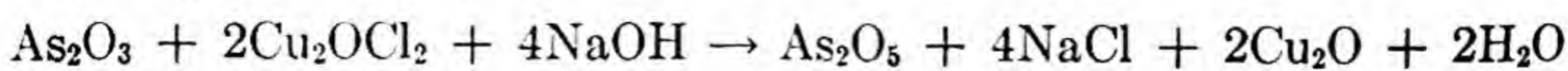


Curtin, Ind. Eng. Chem., **19**, 994 (1927)

24

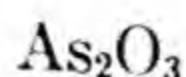
Cu₂OCl₂
As₂O₃
I-1294

Cuprous oxide separates when a solution of arsenic trioxide is warmed with copper oxychloride.

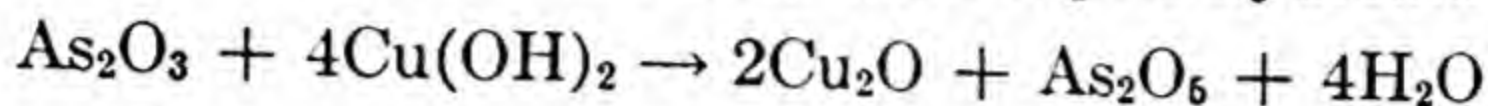


Reichard, Ber., **30**, 1913 (1897)

25

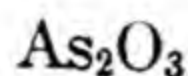
**Cu(OH)₂****I-1295**

Cuprous oxide and arsenic pentoxide are formed when arsenic trioxide dissolved in sodium hydroxide reacts with cupric hydroxide.

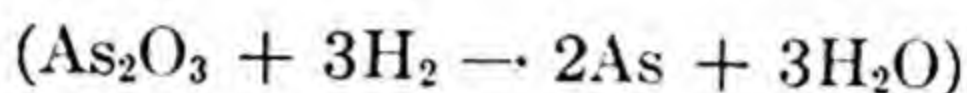


Reichard, Ber., **30**, 1913 (1897)

25

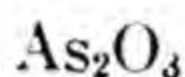
**H₂****I-1296**

Amorphous arsenic is obtained upon reduction of arsenic trioxide with hydrogen.

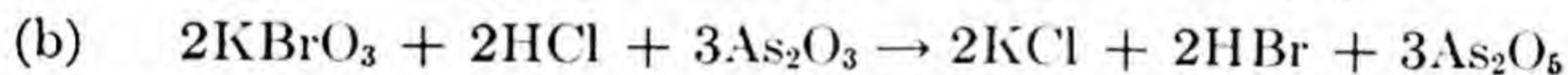
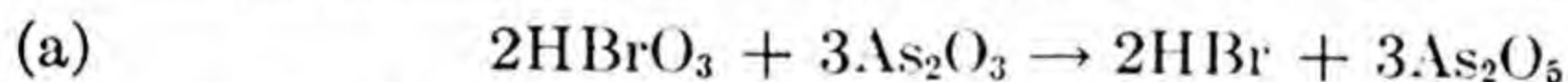


Porphyry N. Laschtschenko, J. Chem. Soc., **121**: **1**, 972 (1922)

48

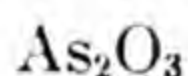
**HBrO₃****I-1297**

Bromic acid is reduced to hydrobromic acid by arsenic trioxide, (a). Potassium bromate is similarly reduced to the bromide, (b).

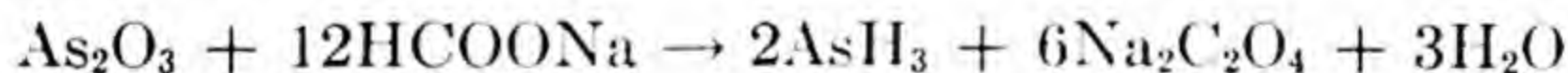


S. Györy, Z. anal. Chem., **32**, 149 (1893)

28

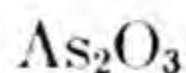
**HCOONa****I-1298**

Arsine is formed as a reduction product when sodium formate is heated with arsenic trioxide.

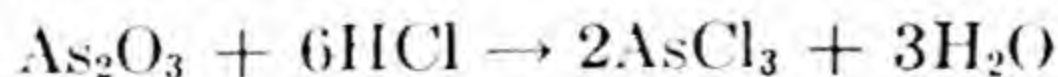


Vournasos: Ber., **43**, 2264 (1910)

25

**HCl****I-1299**

Arsenic trichloride is formed when a hydrochloric acid solution of arsenic trioxide is distilled in a current of hydrogen chloride.



Foulk and Horton, J. Am. Chem. Soc., **51**, 2417 (1929)

1

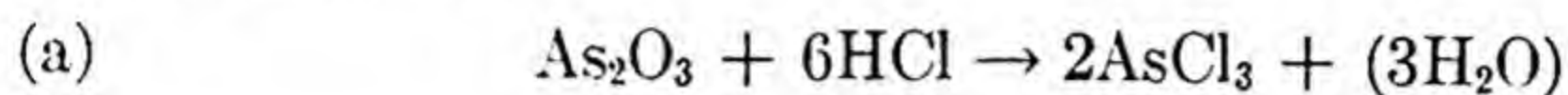


HCl

I-1300

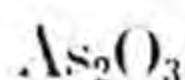
€

Arsenic oxide, when put in a drop of hydrochloric acid on platinum and both touched by zinc, dissolves and plates out as an iridescent film on the platinum. Arsenious and arsenic acid, potassium and calcium arsenates and arsenites, arsenious chloride, and freshly made arsenious sulfide all give the same test.



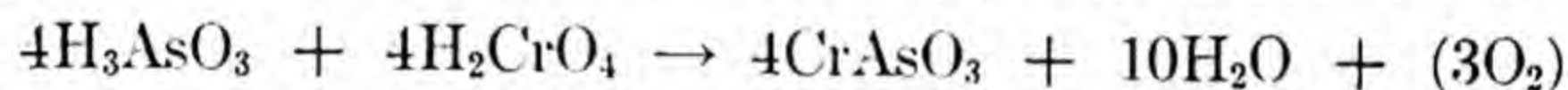
Edmund Davy, Trans. Roy. Soc. (London), **121**, 150 (1831)

105

H₂CrO₄

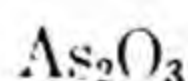
I-1301

When a concentrated and hot solution of chromic acid is poured into a hot, saturated solution of arsenious acid ($\text{As}_2\text{O}_3 + \text{H}_2\text{O}$) the liquid turns green and after a while a dark green precipitate settles out.



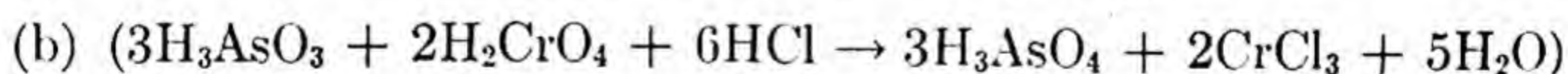
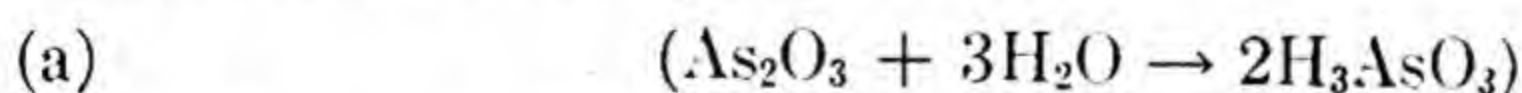
R. H. C. Neville, Chem. News, **34**, 220 (1876)

25

H₂CrO₄

I-1302

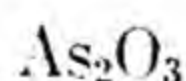
Addition of a slight excess of arsenic trioxide to a hydrochloric acid solution of dilute chromic acid or chromate results in the quantitative reduction of the chromate.



Spitalsky, Z. anorg. Chem., **69**, 179 (1911)

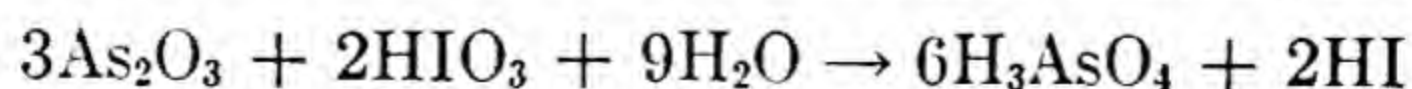
Ref., Kolthoff and Sandell, Ind. Eng. Chem. Anal. Ed., **2**, 141 (1930)

33

HIO₃

I-1303

An excess of iodic acid oxidizes arsenic trioxide to arsenic acid.

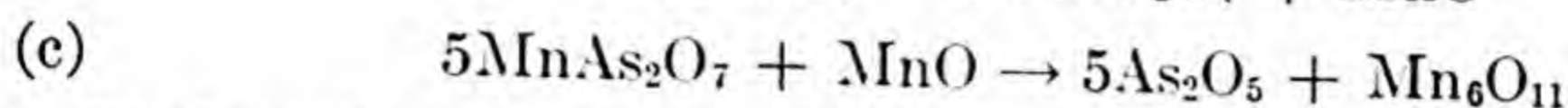
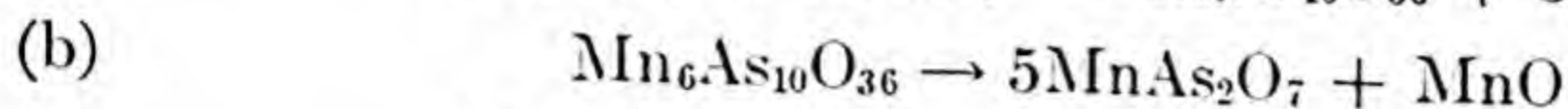
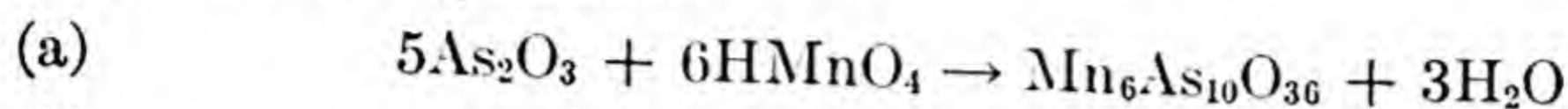


J. Thomsen, Ber., **7**, 1002 (1874)

25

HMnO₄**As₂O₃****I-1304**

The reaction of arsenic trioxide on permanganic acid in the cold, in the presence of a soluble silver salt and in an acid solution may be written in the following manner.

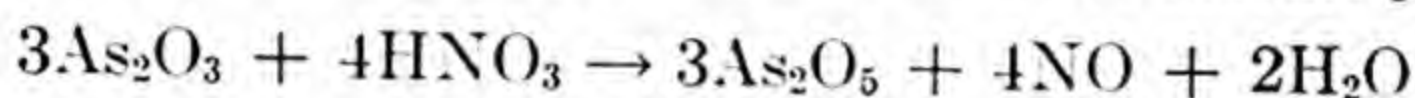


L. Bertiaux, Bull. Soc. Chim. [IV], **35**, 1341 (1924)

31

As₂O₃**HNO₃****I-1305**

30° Baumé nitric acid will oxidize white arsenic to arsenic pentoxide.



C. M. Smith and G. E. Miller, Ind. Eng. Chem., **16**, 1168 (1924)

23

As₂O₃**HNO₃****I-1306**

White arsenic is oxidized by concentrated nitric acid (sp. gr. 1.33) to produce arsenic acid.

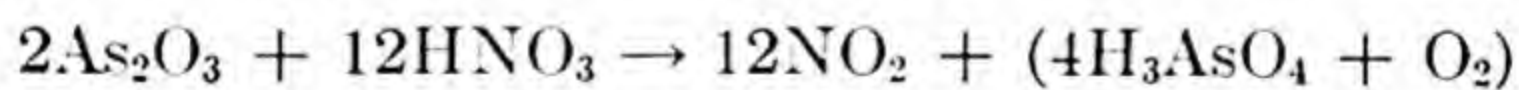


C. W. Drury and C. W. Simmons, Can. Chem. Met. Eng. **9**, 179 (1925)

15

As₂O₃**HNO₃****I-1307**

Nitrogen peroxide is produced by condensing in a freezing mixture the vapors evolved when nitric acid reacts with arsenious oxide.



Tartar and Semon, J. Am. Chem. Soc., **43**, 494 (1921)

1

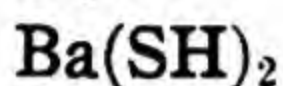
As₂O₃**HNO₃****I-1308**

Arsenic acid is formed when nitric acid oxidizes arsenic trioxide in the presence of water.



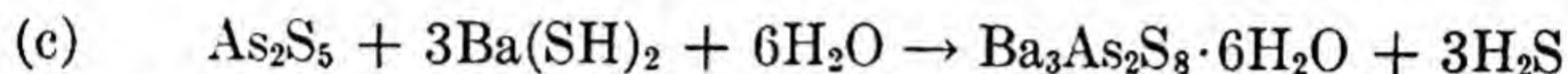
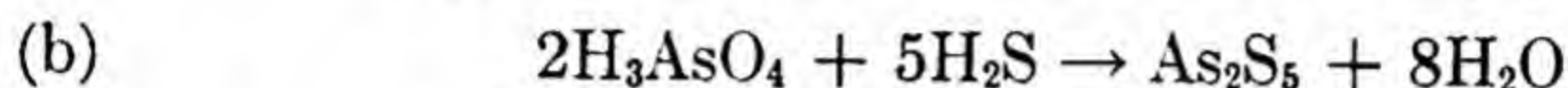
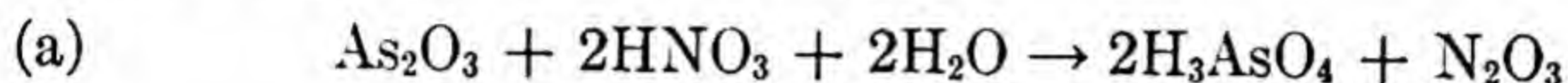
Glatzel, Z. anorg. Chem., **70**, 86 (1911)

25



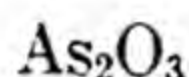
I-1309

Arsenic trioxide is dissolved in nitric acid. By adding hydrogen sulfide arsenic pentasulfide is obtained. This precipitate is brought to reaction with barium hydrosulfide solution; barium orthothioarsenate crystals of yellow color are obtained.



E. Glatzel, *Z. anorg. Chem.*, **70**, 86 (1911)

28



I-1310

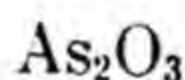
Arsenic trioxide boiled with water forms arsenious acid and arsine.



C. Z. Cross and A. F. Higgin, *Ber.*, **16**, 1195 (1883)

Ref., *C. E. M., Science*, **2**, 408 (1883)

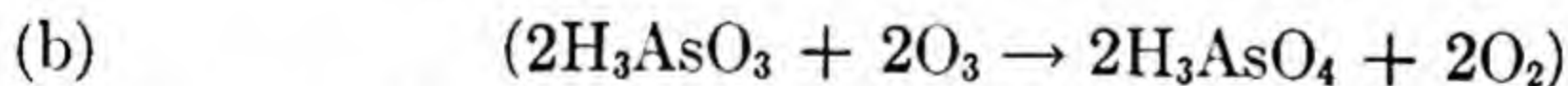
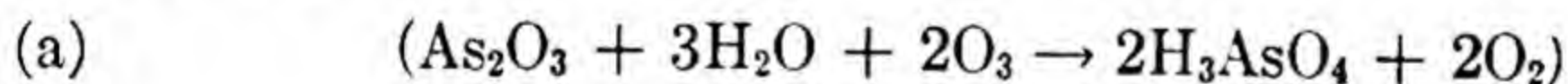
78



I-1311

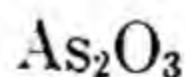


Ozone oxidizes arsenious acid, or a mixture of arsenic trioxide and water, to arsenic acid.



C. Herlin, *Sv. Kem. Tidsk.*, **13**, 156 (1901)

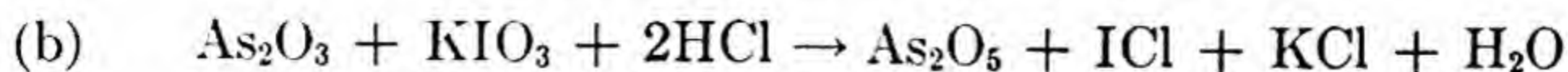
10



I-1312

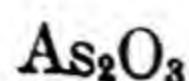


A hydrogen peroxide quantitative method, which employs the oxidation of arsenite solutions, is based on the following equations.

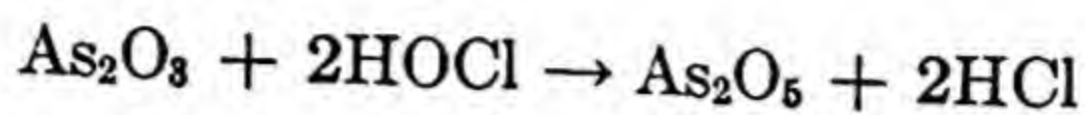


J. S. Reichert S. A. McNeight and H. W. Rudel, *Ind. Eng. Chem., Anal. Ed.*, **11**, 194 (1939)

44

**HOCl****I-1313**

Hypochlorous acid reacts with arsenic trioxide to yield arsenic pentoxide and hydrochloric acid.

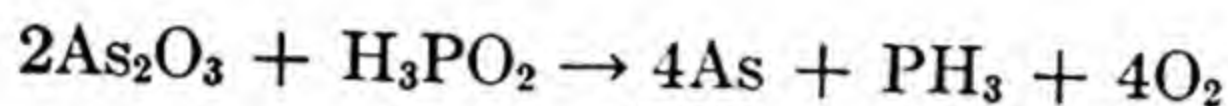


R. L. Taylor, J. Chem. Soc. (London), **97**, Pt. 2, 2541 (1910)

103

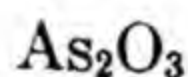
**H₃PO₂****I-1314**

When a solution of arsenic trioxide in hydrochloric acid is treated with hypophosphorous acid in excess, a brown precipitate of finely divided arsenic is formed.

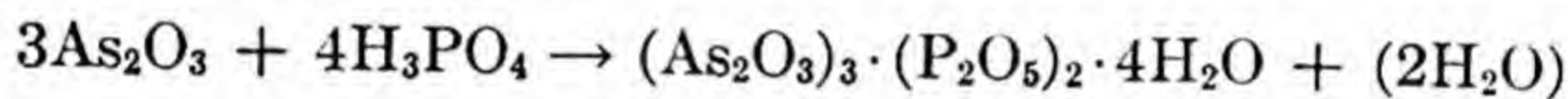


Engel, Compt. Rend., **77**, 1545 (1873)

29

**H₃PO₄****I-1315**

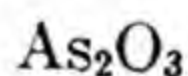
An arsenic phosphate is formed when arsenic trioxide dissolves in hot concentrated phosphoric acid.



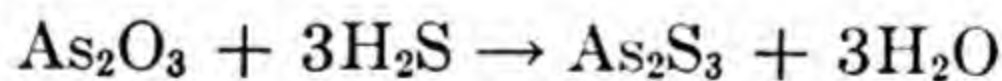
A. de Schulten, Acta. soc. scient. fenn., **20**, No. 4

Ref., Ber., **28**, 901 (1895)

25

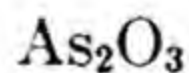
**H₂S****I-1316**

When arsenic trioxide is treated with hydrogen sulfide, arsenic trisulfide and water are produced.

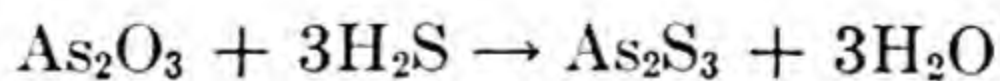


F. L. Usher and M. W. Travers, J. Chem. Soc. (London), **87**, 1371 (1905)

102

**H₂S****I-1317**

Arsenic trisulfide is formed when hydrogen sulfide reacts with arsenic trioxide.



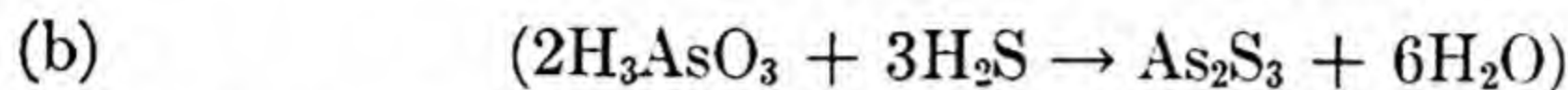
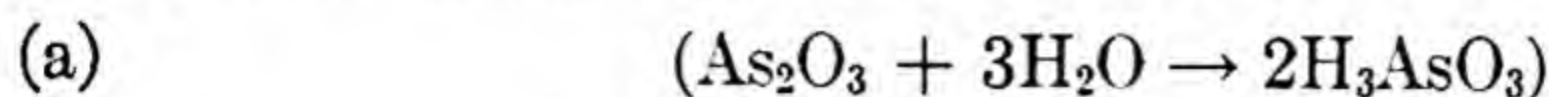
J. Thill, Z. anal. Chem., **38**, 342 (1899)

25

As_2O_3

H₂S **I-1318**

Purified hydrogen sulfide passed through a solution of arsenic oxide precipitates arsenic sulfide, often in colloidal condition.



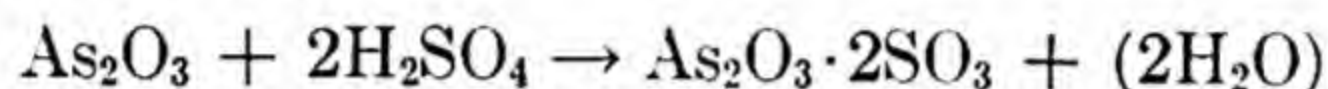
T. Svedberg. Ark. Kem., Min., Geol. **3**, Part 20, 5 (1909)

10

As_2O_3

H₂SO₄ **I-1319**

A double compound is formed when arsenic trioxide dissolves in concentrated sulfuric acid.



R. H. Adie, J. Chem. Soc., (London) 157 (1889)

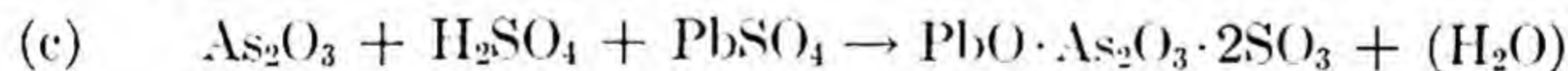
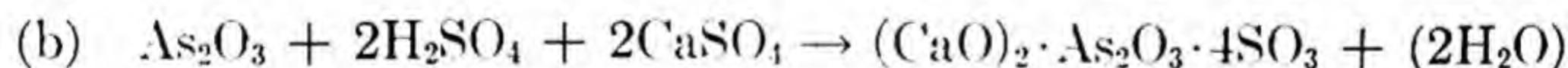
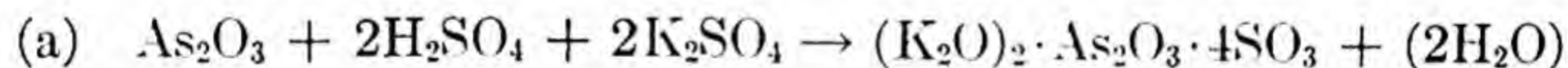
Ref., Ber., **22**, 432 (1889)

25

As_2O_3

H₂SO₄ **I-1320**
K₂SO₄
CaSO₄
PbSO₄

Arsenic trioxide and the metallic sulfate were dissolved in concentrated sulfuric acid, and the latter driven off by heating. Crystalline compounds were produced.



H. Kuhl, Arch. Pharm., **245**, 377 (1907)

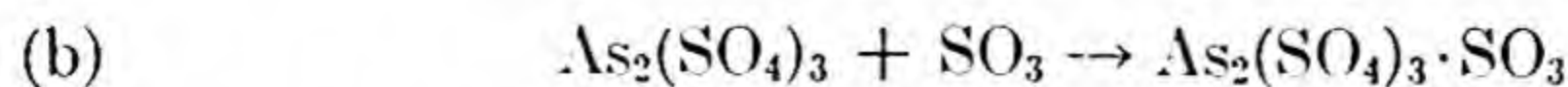
Ref., C. F. Baker, J. Chem. Soc., (London) **94**, (2) 36 (1908)

57

As_2O_3

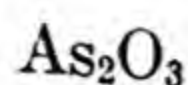
H₂SO₄·SO₃ **I-1321**

Arsenic trioxide forms arsenous sulfate when evaporated with sulfuric acid. Arsenous sulfate is soluble in fuming sulfuric acid to form an addition product.



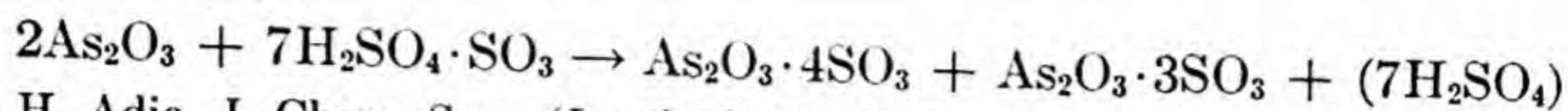
C. Schultz-Sellack, Ber., **4**, 112 (1871)

11



I-1322

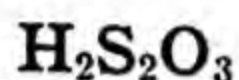
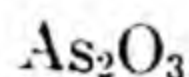
A double compound is formed when arsenic trioxide is dissolved in fuming sulfuric acid. The latter compound crystallizes from the mother liquor.



R. H. Adie, J. Chem. Soc., (London) 157 (1889)

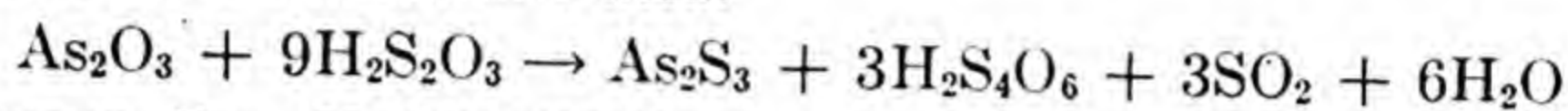
Ref., Ber., **22**, 432 (1889)

25



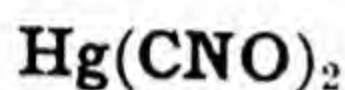
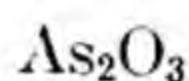
I-1323

Arsenic trioxide is completely converted into the sulfide when an excess of it reacts with thiosulfuric acid.



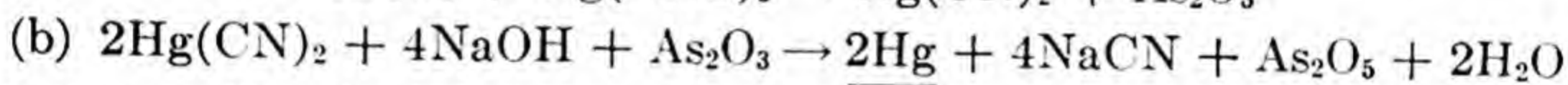
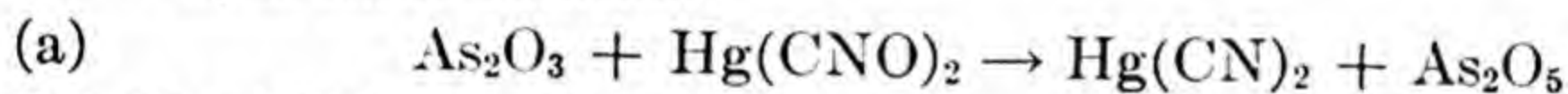
G. Vortmann, Ber., **22**, 2307 (1889)

25



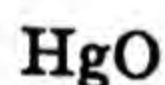
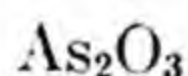
I-1324

Mercury is precipitated and arsenic trioxide oxidized when this substance is treated with fulminate of mercury in the presence of 20% sodium hydroxide solution.



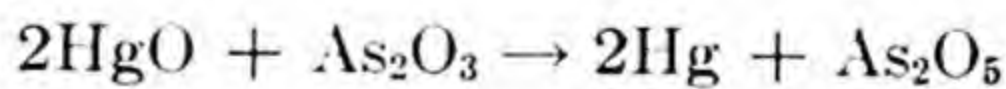
Gutmann, Ber., **42**, 3623 (1909)

25



I-1325

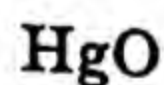
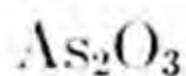
In alkaline solutions of mercuric oxide, arsenic trioxide precipitates mercury on boiling.



W. Feit, Z. anal. Chem., **28**, 318 (1889)

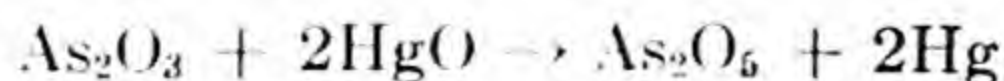
Ref., J. F. G., J. Am. Chem. Soc., **12**, 16 (1890)

1



I-1326

Arsenic pentoxide and metallic mercury are formed when an alkaline solution of arsenic trioxide is boiled with mercuric oxide.



W. Feit, Z. anal. Chem., **28**, 314 (1889)

Ref., Reichard, Ber., **30**, 1913 (1897)

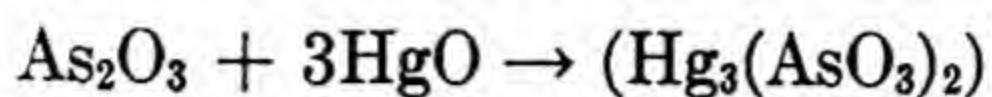
25



HgO

I-1327

A black mercury arsenite is formed when red mercuric oxide is heated with arsenic trioxide dissolved in sodium hydroxide.



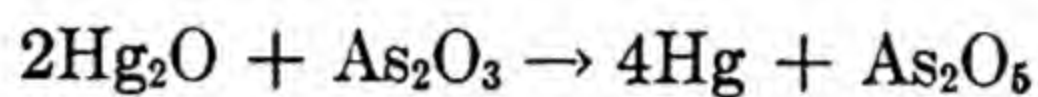
Reichard, Ber., **30**, 1913 (1897)

25

Hg₂O

I-1328

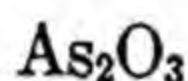
In boiling alkaline solutions of mercurous oxide, arsenic trioxide precipitates mercury.



W. Feit, Z. anal. Chem., **28**, 314, 318 (1889)

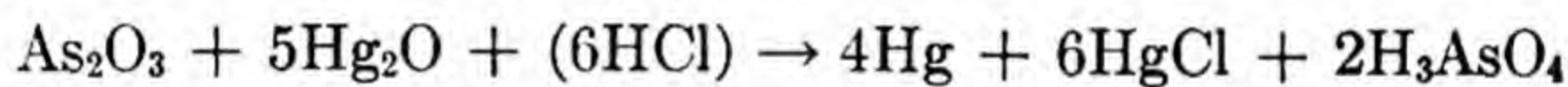
Ref., J. F. G., J. Am. Chem. Soc., **12**, 16 (1890)

1

Hg₂O

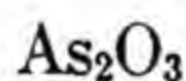
I-1329

A precipitate of mercury and mercurous chloride is formed when arsenic trioxide dissolved in sodium hydroxide is treated with mercurous oxide and then warmed with hydrochloric acid.



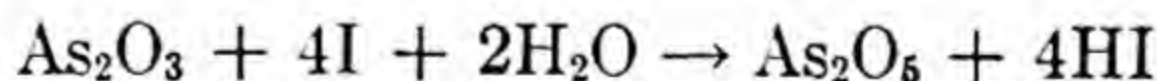
Reichard, Ber., **30**, 1913 (1897)

25

I + H₂O

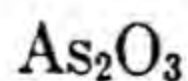
I-1330

Arsenic trioxide reacts with water and iodine to give arsenic pentoxide and hydriodic acid.



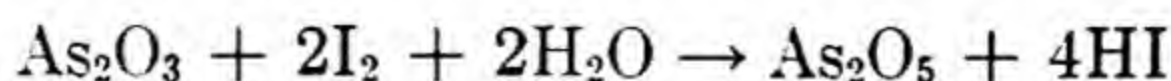
Rodolfo Namias: Gazz. Chim. Ital. **22**¹, 509 (1892)

21

I + H₂O

I-1331

If the hydrogen iodide is neutralized by sodium bicarbonate as rapidly as it is formed, iodine will oxidize arsenic trioxide to arsenic pentoxide.



Holland, J. Ind. Eng. Chem. **3**, 168 (1911)

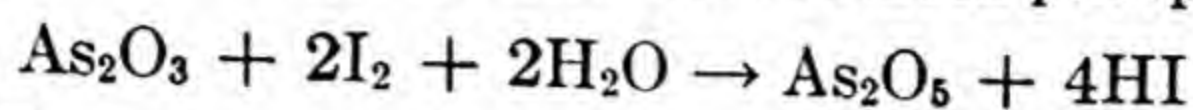
Ref., Curry and Smith, J. Ind. Eng. Chem., **4**, 199 (1912)

23



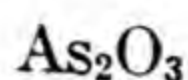
I₂ **I-1332**

Iodine can be titrated by arsenic trioxide even in presence of nitrites provided the solution is kept neutral with sodium phosphates:



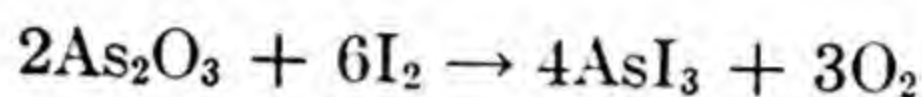
A. Berthoud and W. Berger, *J. Chim. phys.*, **25**, 542 (1928)

69



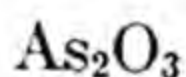
I₂ **I-1333**

Arsenic triiodide is formed when arsenic trioxide is heated in iodine vapor.



C. Brame, *Compt. Rend.*, **33**, 579 (1851)

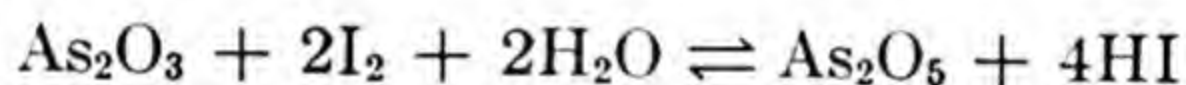
29



I₂ **I-1334**



Ordinarily, in acid solution an equilibrium exists between arsenic trioxide and free iodine.

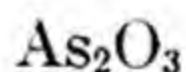


Victor E. Herschlag, *Ind. Eng. Chem., Anal. Ed.*, **13**, 561 (1941)

Ref., P. Fleury, *Bull. Soc. Chim.*, [IV], **27**, 491 (1920)

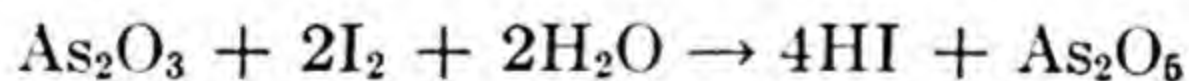
44

31



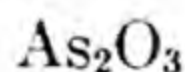
I₂ + H₂O **I-1335**

On boiling a mixture of iodine, water and arsenic trioxide the products will be hydriodic acid and arsenic pentoxide.

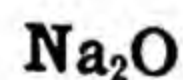


C. Maselli, *Gazz. Chim. Ital.* **35**¹, 268 (1905)

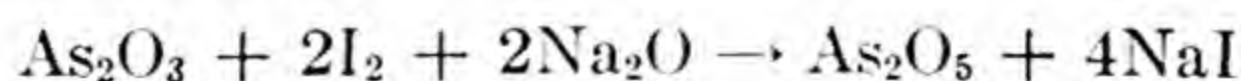
21



I₂ **I-1336**



Arsenic trioxide is transformed to arsenic pentoxide by the action of iodine and sodium oxide.



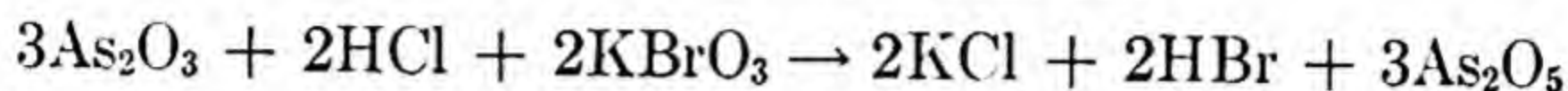
British Pharmacopocia, *Chem. News*, **9**, 99 (1864)

101



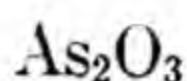
I-1337

A concentrated hydrochloric acid solution of arsenic trioxide may be titrated with 0.2*N* potassium bromate solution.



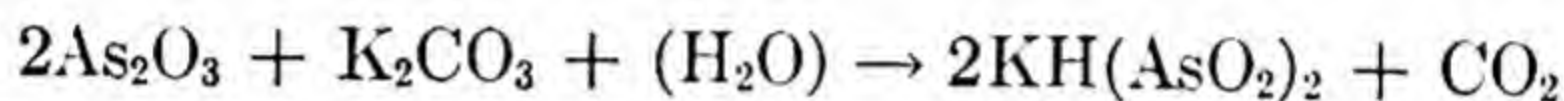
Mayr, *Z. anorg. Chem.*, **137**, 329 (1925)

25



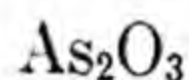
I-1338

Potassium hydrogen metarsenite is obtained when arsenic trioxide is added in small amounts to a hot concentrated solution of potassium carbonate.



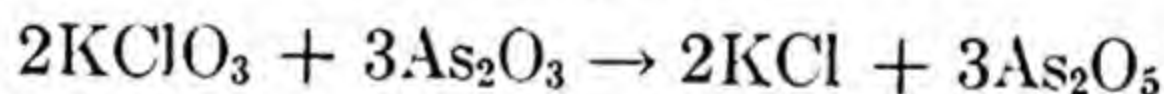
Reichard, *Ber.*, **27**, 1019 (1894)

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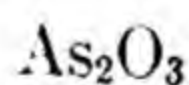
I-1339

Arsenic trioxide reacts with potassium chlorate in hydrochloric acid to give potassium chloride and arsenic pentoxide.



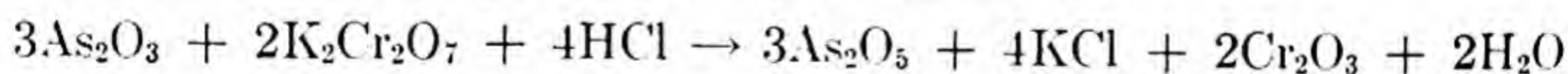
Rodolfo Namias, *Gazz. Chim. Ital.*, **22**¹, 510 (1892)

21



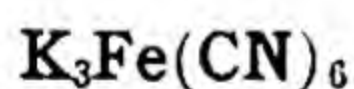
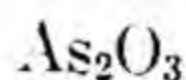
I-1340

Arsenic pentoxide is formed when potassium dichromate oxidizes arsenic trioxide in the presence of hydrochloric acid.



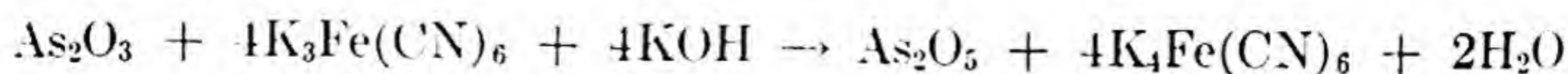
E. Waitz: *Z. anal. Chem.*, **10**, 158 (1871)

25



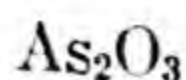
I-1341

Arsenic trioxide is oxidized by an alkaline solution of potassium ferricyanide.

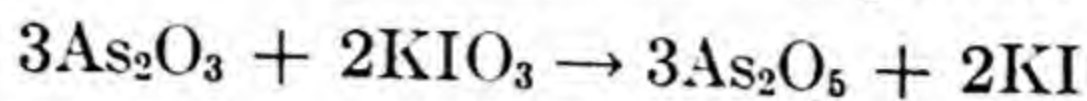


Palmer: *Z. anorg. Chem.* **67**, 317 (1910)

25

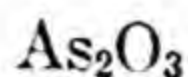
**KIO₃****I-1342**

Arsenious compounds react with potassium iodate in a 20% solution of hydrochloric acid forming the arsenic compounds.

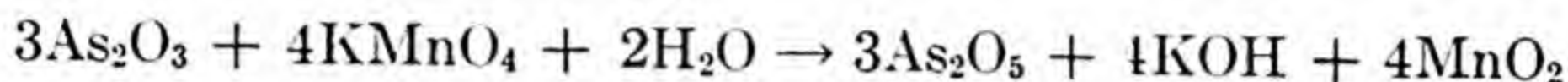


G. S. Jamieson, *J. Ind. Eng. Chem.*, **10**, 291 (1918)

22

**KMnO₄****I-1343**

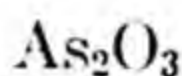
Potassium permanganate in either neutral or alkaline solution oxidizes arsenic trioxide quantitatively.



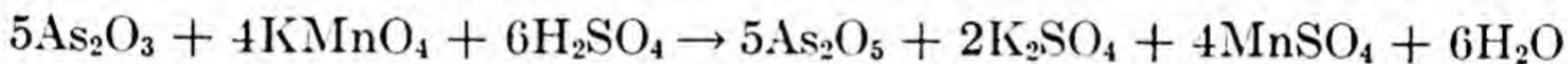
Donath and Schoffee: *Monatsh.*, **7**, 644 (1886)

Ref., B. Brauner, *Z. anal. Chem.*, **55**, 242 (1916)

25

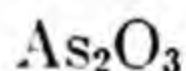
**KMnO₄****I-1344****H₂SO₄**

Arsenic trioxide is oxidized to arsenic pentoxide by potassium permanganate in the presence of sulfuric acid.

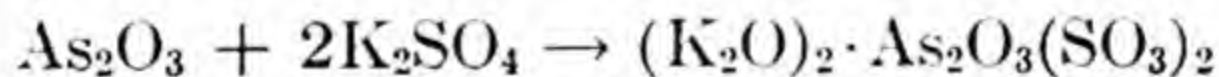


W. Trautmann, *Z. anal. Chem.*, **50**, 371 (1911)

25

**K₂SO₄****I-1345**

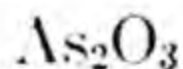
A crystalline compound is obtained when potassium sulfate and arsenious oxide are dissolved in sulfuric acid and excess sulfuric acid driven off by heat.



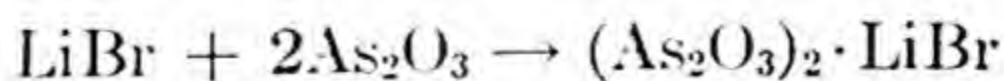
Kuhl, *Arch. Pharm.*, **245**, 377 (1907)

Ref. *J. Chem. Soc. (London)*, **94**, 36 (1908)

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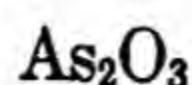
**LiBr****I-1346****H₂O**

The binary system of lithium bromide and arsenic trioxide is formed in water at 30°.

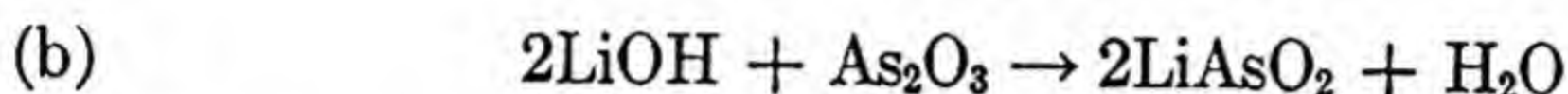
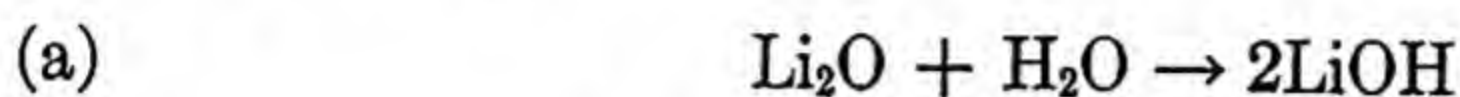


F. A. H. Schreinemakers and W. C. de Baat, *Chem. Weekblad*, **14**, 141 (1917)

2

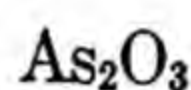
**Li₂O****I-1347****H₂O**

Lithium metarsenite is formed in water at 25°. It is soluble in water without decomposition.

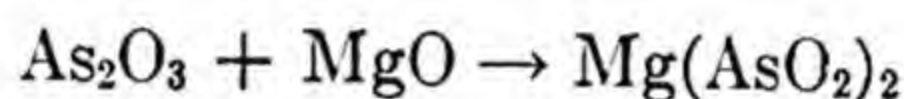


F. A. H. Schreinemakers and W. C. de Baat, *Rec. trav. chim.* **39**, 423 (1920)

2

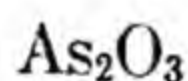
**MgO****I-1348**

Magnesium metarsenite is formed when a mixture of arsenic trioxide and magnesium oxide is heated to 300°.



Kalsing, *Z. anorg. Chem.*, **149**, 68 (1925)

25

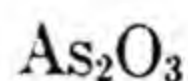
**MnO₂****I-1349**

Arsenic pentoxide is formed when a hydrochloric acid solution of arsenic trioxide is warmed with manganese dioxide. The same oxidation is accomplished with manganese trioxide, (b).

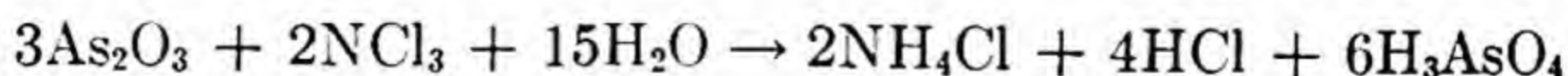


W. Schranz, *Z. anal. Chem.*, **37**, 444 (1898)

25

**NCl₃****I-1350**

Arsenic acid is formed when a benzene solution of nitrogen trichloride is shaken with a solution of arsenic trioxide in sodium bicarbonate solution.



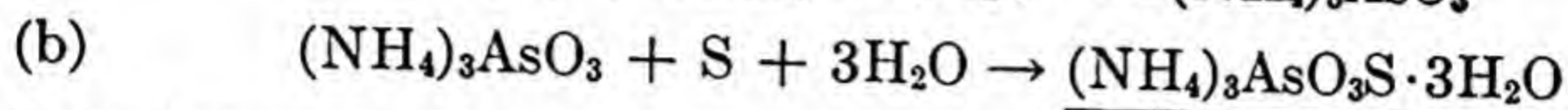
Hentschel, *Ber.*, **30**, 1434 (1897)

Ref., Noyes and Lyon, *J. Am. Chem. Soc.*, **23**, 462 (1901)

1

NH₃**As₂O₃****S****I-1351**

White crystals are obtained by heating arsenic trioxide with concentrated ammonia in a pressure bottle on a water bath.

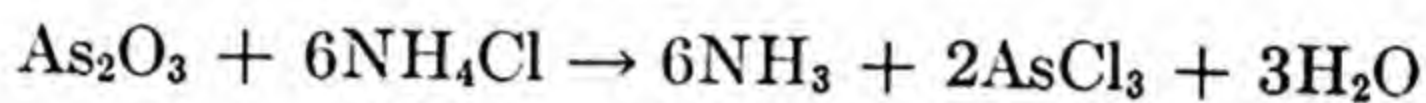


R. F. Weinland and O. Rumpf, *Z. anorg. Chem.*, **14**, 42 (1897)

28

As₂O₃**NH₄Cl****I-1352**

By heating arsenic trioxide with ammonium chloride, arsenic trichloride is formed and ammonia is evolved.

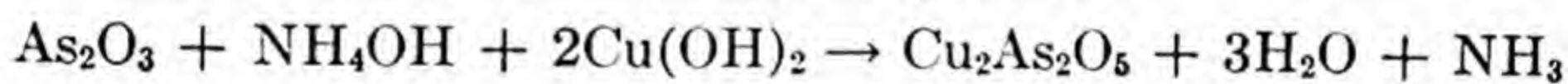


deLuynes, *Compt. Rend.*, **44**, 1354 (1857)

29

As₂O₃**NH₄OH****I-1353****Cu(OH)₂**

Copper arsenite separates when cupric hydroxide is heated with a solution of arsenic trioxide in ammonium hydroxide.



Bloxam, *Ber.*, **27**, 1019 (1894)

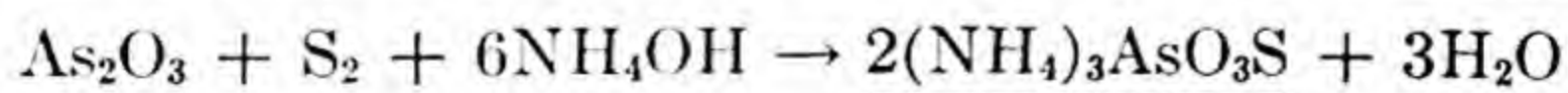
Ref., Reichard, *Ber.*, **30**, 1913 (1897)

Ref., Girard, *Compt. Rend.*, **36**, 793

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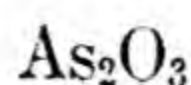
As₂O₃**NH₄OH****I-1354****S₂**

Ammonium monothioarsenate is obtained as an oily precipitate when a mixture of sulfur and arsenic trioxide is heated, the melt finely powdered and then treated with ammonium hydroxide and alcohol.

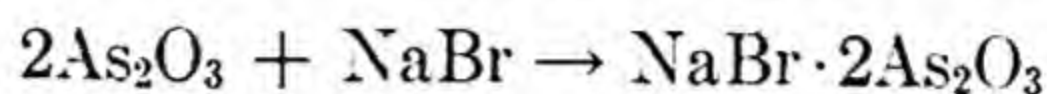


McLauchlan, *Ber.*, **34**, 2166 (1901)

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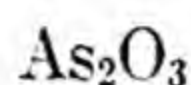
**NaBr****I-1355**

Six-sided tabular crystals are obtained when a water solution of arsenic trioxide and sodium bromide is boiled and allowed to cool and crystallize.

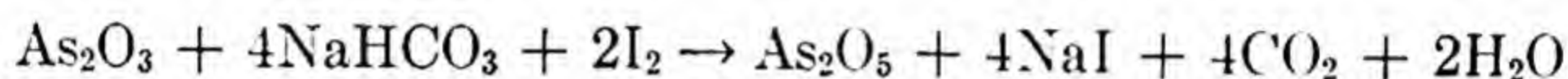


F. Rudorff: Ber., **21**, 3051 (1888)

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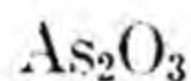
**NaHCO₃****I-1356****I₂**

Arsenic trioxide is oxidized by iodine in the presence of sodium bicarbonate.

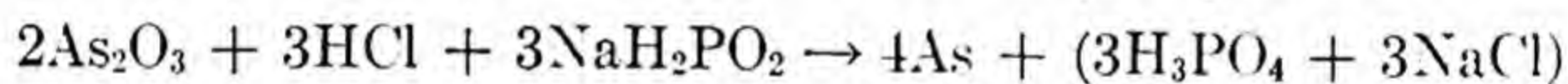


L. Rosenthaler: Z. anal. Chem., **45**, 596 (1906)

25

**NaH₂PO₂****I-1357**

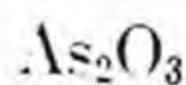
When a hydrochloric acid solution of arsenic trioxide is reduced with sodium hypophosphite, amorphous arsenic is precipitated.



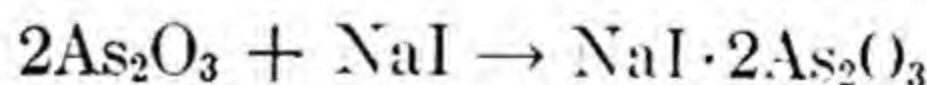
V. Auger: Compt. rend., **145**, 808 (1907)

Ref.: E. Horton, J. Chem. Soc. (London), **94**, 13 (1908)

57

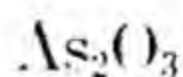
**NaI****I-1358**

Six-sided crystals are obtained if a water solution of arsenic trioxide and sodium iodide is warmed and allowed to cool and crystallize.

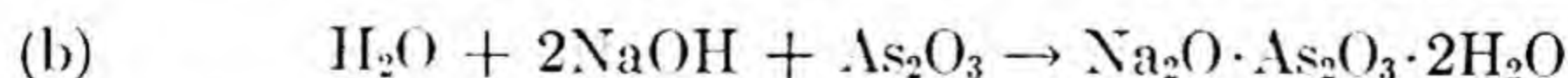
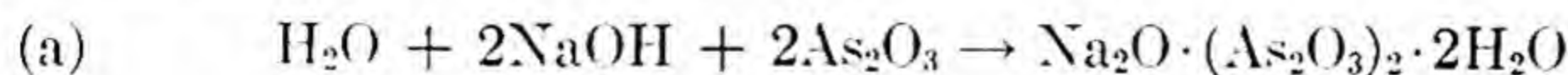


F. Rudorff: Ber., **21**, 3051 (1888)

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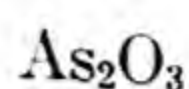
**NaOH****I-1359**

When sodium hydroxide is added to arsenious oxide one or the other of the following reactions takes place.

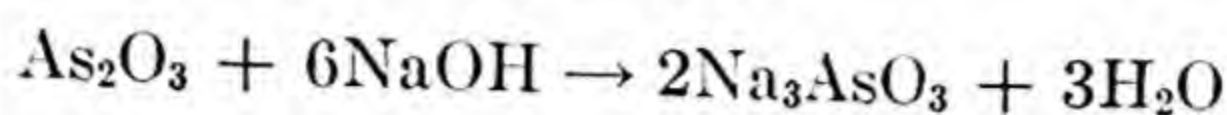


W. T. McGeorge, J. Agr. Res., **5**, 461 (1915)

67

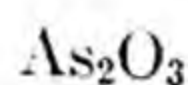
**NaOH****I-1360**

Sodium arsenite is prepared by dissolving arsenic trioxide in sodium hydroxide. Considerable heat is evolved.

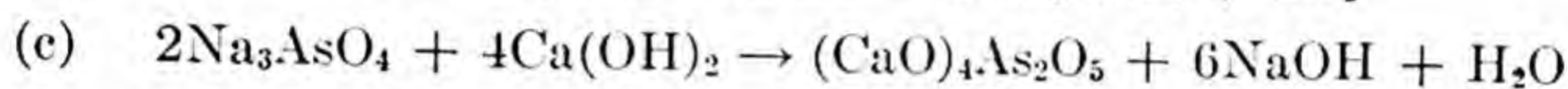
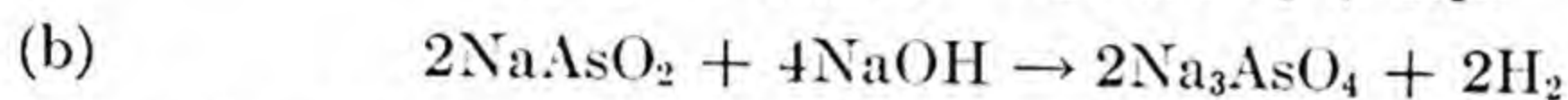
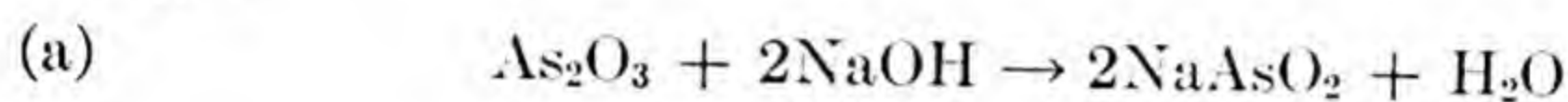


Uhlinger and Cook, *J. Ind. Eng. Chem.*, **11**, 105 (1919)

22

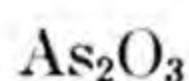
**NaOH****I-1361**

Basic calcium arsenate may be prepared from the unpurified, first roast precipitate or gray arsenic (90-95% As_2O_3) by the following changes.

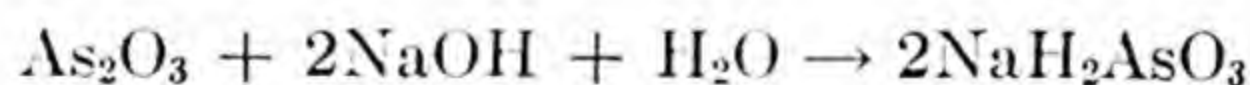


Stewart J. Lloyd and A. M. Kennedy, *Chem. Met. Eng.*, **32**, 624 (1925)

44

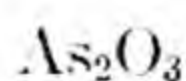
**NaOH****I-1362**

Tenth normal sodium arsenite was prepared by dissolving 5 grams of reagent arsenic trioxide in 40 cc. of 5 normal sodium hydroxide. The solution, diluted to 400 cc., was neutralized with normal hydrochloric acid, and then made just slightly acid. 2 g. of sodium hydrogen carbonate were dissolved in the solution, followed by sufficient water to make one liter.

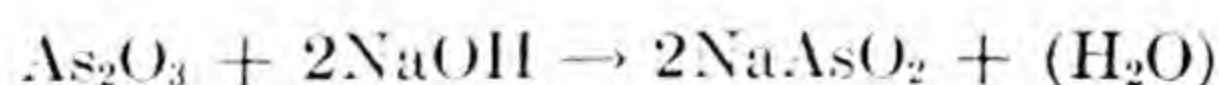


B. S. Alstodt, *J. Am. Pharm. A.*, **29**, 227 (1940)

112

**NaOH****I-1363**

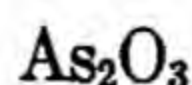
Arsenic trioxide reacts with sodium hydroxide solution to form sodium metarsenite.



Shields, *Z. phys. Chem.*, **12**, 167 (1893)

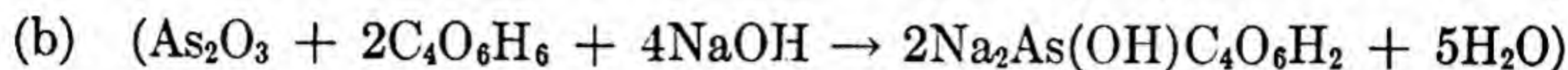
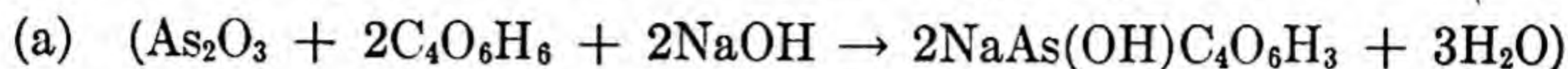
Ref., J. K. Wood, *J. Chem. Soc.*, (London), **93**, 415 (1908)

57



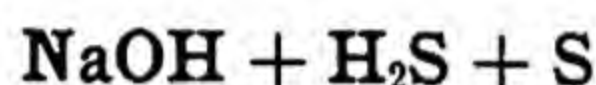
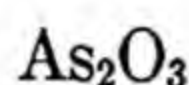
I-1364

The neutralization curve of a solution of arsenic trioxide in tartaric acid with sodium hydroxide reveals the following complexes:



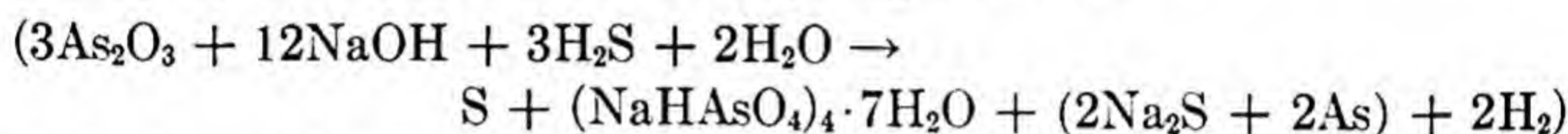
J. L. Delsal, *J. Chim. phys.*, **35**, 350 (1938)

69



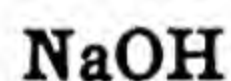
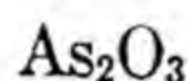
I-1365

Colorless crystals of disodium acid ortho arsenate are formed when arsenic trioxide and flowers of sulphur are dissolved in a solution of sodium hydroxide saturated with hydrogen sulfide.



Preis, *Ann.*, **257**, 189 (1890)

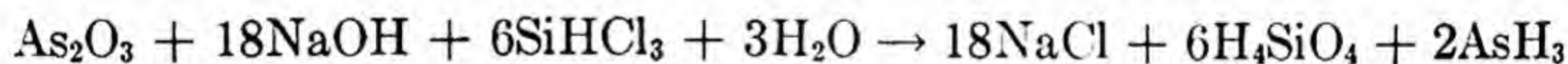
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I-1366

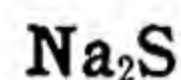
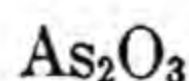


Arsenic is obtained as a reduction product when arsenic trioxide is treated with silicochloroform and then moistened with sodium hydroxide.



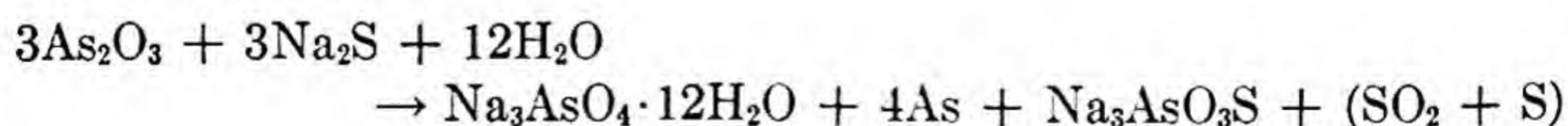
Ruff and Albert: *Ber.*, **38**, 2222 (1905)

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I-1367

The normal sodium thioarsenate is formed along with some sodium oxythioarsenate and arsenic when a solution of sodium sulfide is heated with arsenic trioxide.



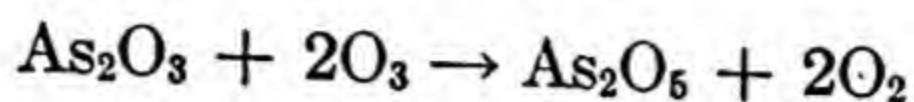
Preis, *Ann.*, **257**, 186 (1860)

25

O₃ **I-1368**

$$\text{As}_2\text{O}_3$$

 Arsenic trioxide is oxidized by ozone.



Yamauchi, Am. Chem. J., **49**, 55 (1913)

Ref., J. L. Howe, J. Am. Chem. Soc., **36**, 241 (1914)

Ref., Soret, Compt. Rend., **38**, 445 (1854)

Yamauchi, Am. Chem. J., **49**, 58 (1913)

1

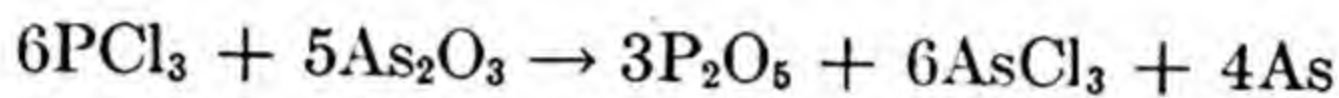
29

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PCl₃ **I-1369**

$$\text{As}_2\text{O}_3$$

Arsenic trioxide at a temperature between 110–130° acts on phosphorus trichloride to yield phosphorus pentoxide, arsenic trichloride and arsenic.



Michaelis, Gazz. Chim. Ital., **1**, 378 (1871)

Ref., J. Chem. Soc. (London), **118**, 308 (1920)

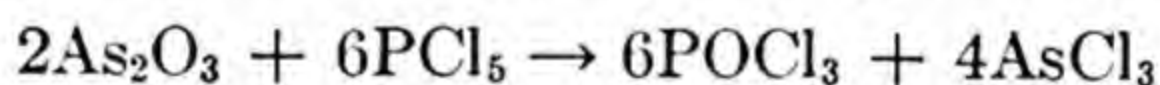
21

25

PCl₅ **I-1370**

$$\text{As}_2\text{O}_3$$

Arsenic trichloride and phosphorus oxychloride are obtained when arsenic trioxide is treated with phosphorus pentachloride.



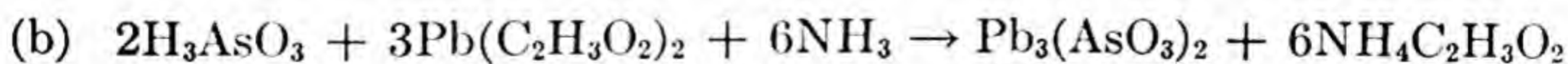
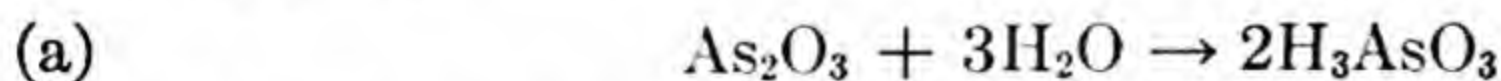
Hurtzig and Geuther, Ann., **111**, 172 (1859)

25

Pb(C₂H₃O₂)₂ **I-1371**

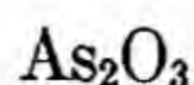
$$\text{As}_2\text{O}_3$$

Lead arsenite was prepared by adding a solution of arsenic trioxide in water to a solution of lead acetate in a little free acetic acid. The slight amount of precipitate that formed on standing overnight was filtered off, and ammonia added in excess to the filtrate, throwing down lead arsenite.

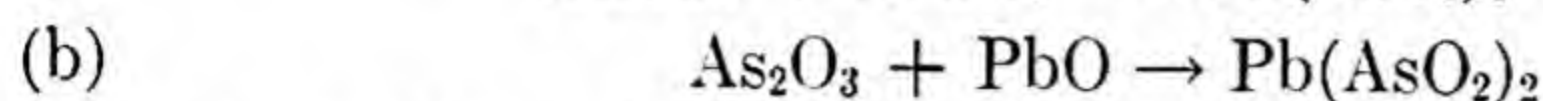
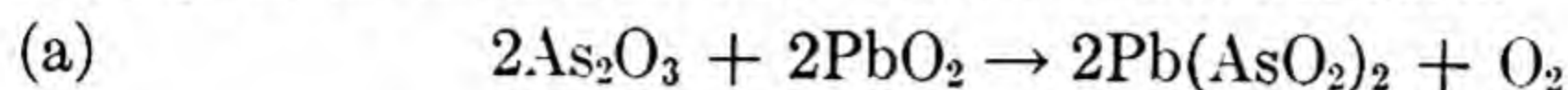


R. C. Roark, J.A.O.A.C., **3**, 332 (1920)

42

**PbO₂****I-1372**

Lead metarsenite is formed along with the evolution of oxygen when arsenic trioxide is brought in contact with glowing lead dioxide. The same product is formed when lead monoxide is used.

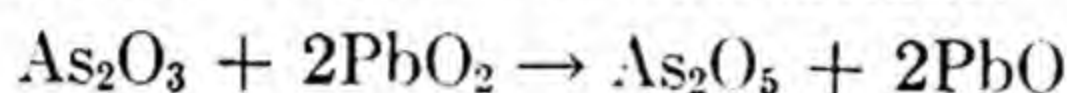


Simon, Ann., **23**, 283 (1837)

25

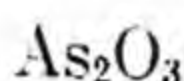
**PbO₂****I-1373**

Arsenic pentoxide is formed when a concentrated sodium hydroxide solution of arsenic trioxide reacts with lead dioxide.

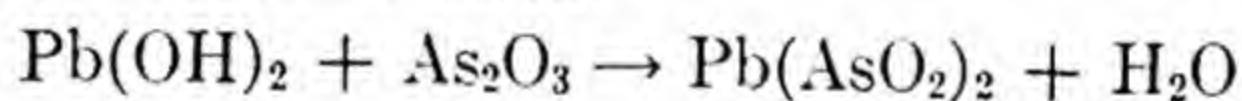


Reichard, Ber., **30**, 1913 (1897)

25

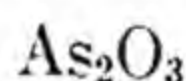
**Pb(OH)₂****I-1374**

Lead metarsenite is obtained when lead hydroxide is treated with an excess of arsenic trioxide solution.

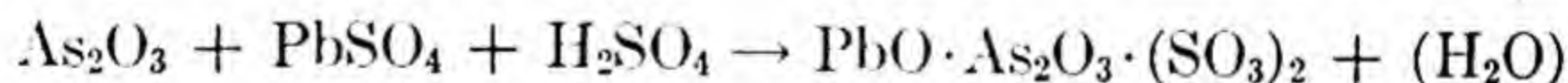


Story and Anderson, J. Am. Chem. Soc., **46**, 538 (1924)

1

**PbSO₄****I-1375**

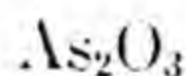
A crystalline compound is formed when arsenic trioxide and lead sulfate are dissolved in sulfuric acid and the solution heated to drive off sulfuric acid.



Kuhl, Arch. Pharm., **245**, 377 (1908)

Ref., J. Chem. Soc., (London), **94**, 36 (1908)

25

**RbCO₃****I-1376**

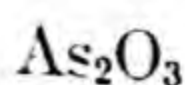
Rubidium metarsenite may be obtained by treating a water solution of arsenic trioxide with rubidium carbonate and evaporating the solution in vacuum. A white amorphous mass forms.



A. Bouchonnet, Compt. Rend., **144**, 641, 18, 3 (1907)

Ref., R. Marquis, Bull. Soc. Chim. (4), **1**, 646 (1907)

31

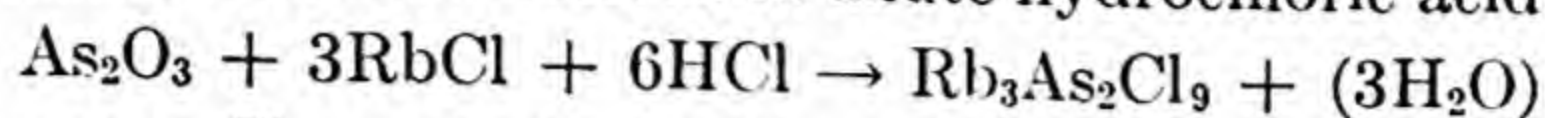


RbCl

HCl

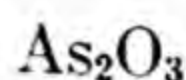
I-1377

Rubidium chloroarsenate is obtained when solutions of rubidium chloride and arsenic trioxide dissolved in dilute hydrochloric acid are mixed.



Wheeler, Z. anorg. Chem., **4**, 451 (1893)

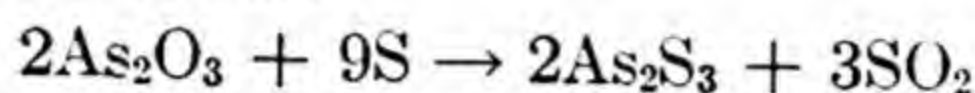
25



S

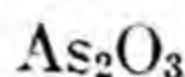
I-1378

Arsenic trisulfide is formed and sulfur dioxide is liberated when arsenic trioxide is heated with sulfur.



Marekwald and Foizik: Ber., **43**, 1720 (1910)

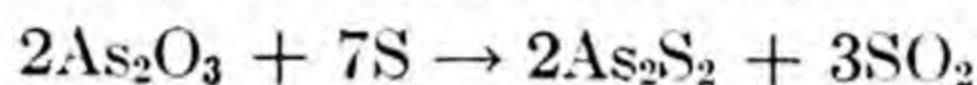
25



S

I-1379

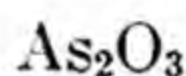
Arsenic oxide, when heated with sulfur in a distillation apparatus, produces arsenic disulfide and sulfur dioxide.



L. F. Nilson, K. Sv. Vet. Akad. Handl., **10**, 5 (1871)

Ref.: Berzelius, Lehrbuch der Chemie., **2**, 268 (1856)

10

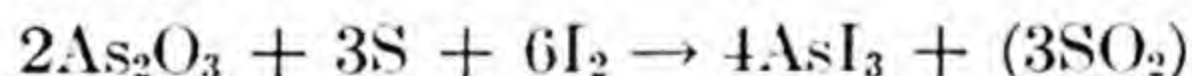


S

I-1380

I₂

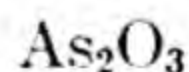
Arsenic triiodide is formed when a mixture of arsenic trioxide, sulfur and iodine is heated.



Oddo and Giachery, Gazz. Chim. Ital., **53**, 56 (1923)

Ref., J. Chem. Soc. (London), **124**, 316 (1923)

25



S

I-1381

NH₄OH

Diammonium hydrogen monothioarsenate separates as a crystalline precipitate when a mixture of sulfur and arsenic trioxide is heated. The finely pulverized melt is treated with ammonium hydroxide and an excess of alcohol.



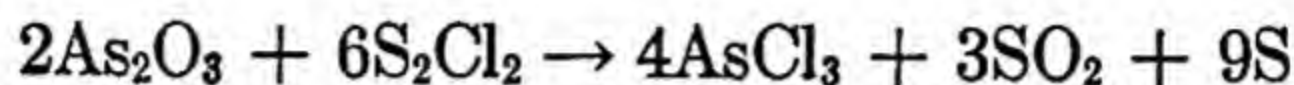
McLauchlan, Ber., **34**, 2166 (1901)

25



I-1382

By heating arsenic trioxide with sulfur monochloride, arsenic trichloride, sulfur dioxide, and sulfur are obtained.



Prinz, Ann., **223**, 357 (1884)

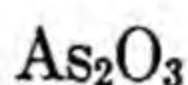
20

Ref., G. Oddo and E. Serra, Gazz. Chim. Ital., **29**², 355 (1899)

21

R. C. Smith, J. Ind. Eng. Chem., **11**, 109 (1919)

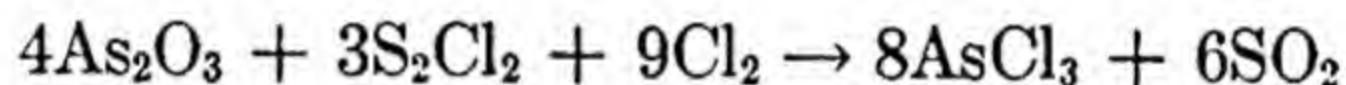
22



I-1383

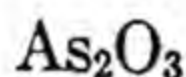


Arsenic trichloride is formed when chlorine is passed into a boiling mixture containing sulfur monochloride and an excess of arsenic trioxide.



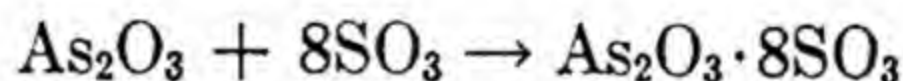
Partington, J. Chem. Soc., (London), 2578 (1929)

25



I-1384

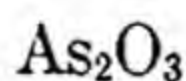
A double compound is obtained when arsenic trioxide is heated in a closed tube with sulfur trioxide.



R. H. Adie, J. Chem. Soc., (London), **55**, 157 (1889)

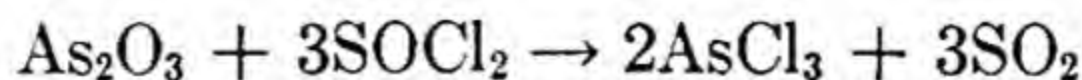
Ref., Ber., **22**, 432 (1889)

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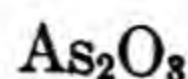
I-1385

Arsenic trioxide reacts with thionyl chloride in the cold producing the chloride.



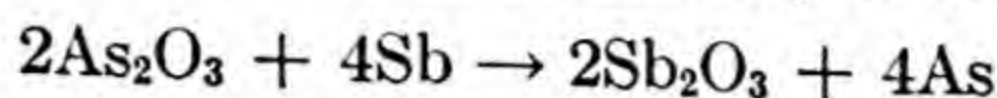
North and Hageman, J. Am. Chem. Soc., **35**, 354 (1913)

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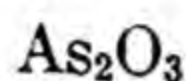
Sb **I-1386**

Antimony displaces arsenic from arsenic trioxide when a mixture of finely powdered arsenic trioxide and antimony is heated to 360°.



Krafft and Neumann: Ber., **34**, 565 (1901)

25



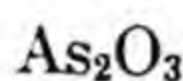
Se₂Cl₂ **I-1387**

The oxides of arsenic, antimony and bismuth are treated with selenium monochloride to yield the corresponding chloride, selenium oxychloride and selenium.



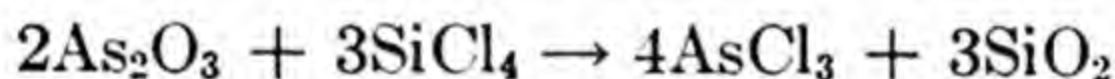
Lenher and Kao, J. Am. Chem. Soc., **48**, 1554 (1926)

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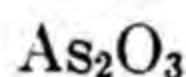
SiCl₄ **I-1388**

Arsenic trichloride forms when arsenic trioxide reacts with silicon tetrachloride in a tube at 270–280° (Heated for about thirty hours).



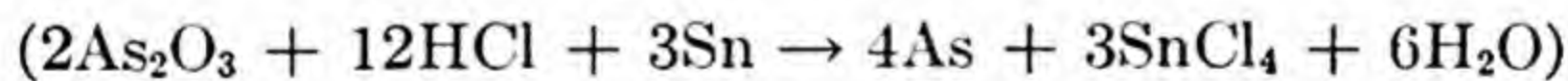
G. Rauter, Ann., **270**, 236 (1892)

25



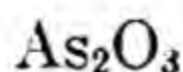
Sn **I-1389**

Amorphous arsenic can be prepared by reducing arsenic trioxide with metallic tin in concentrated hydrochloric acid.



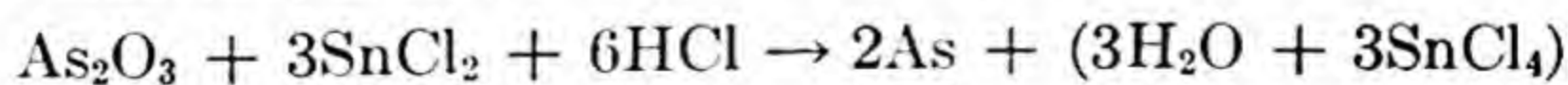
Porphyry N. Laschtschenko, J. Chem. Soc. (London), **121**, 973 (1922)

48



SnCl₂ **I-1390**

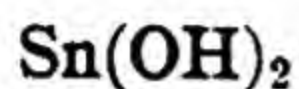
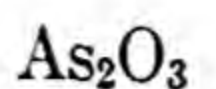
When a hydrochloric acid solution of arsenic trioxide is reduced with stannous chloride, amorphous arsenic is produced.



V. Auger: Compt. rend., **145**, 808–811 (1907)

Ref.: E. Horton, J. Chem. Soc., (London), **94**, 13 (1908)

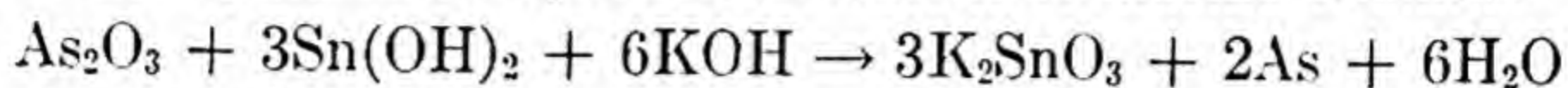
57



I-1391

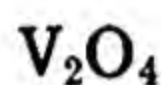
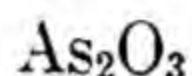


Potassium stannate and arsenic are formed when stannous hydroxide reacts with a potassium hydroxide solution of arsenic trioxide.



Reichard, Ber., **30**, 1913 (1897)

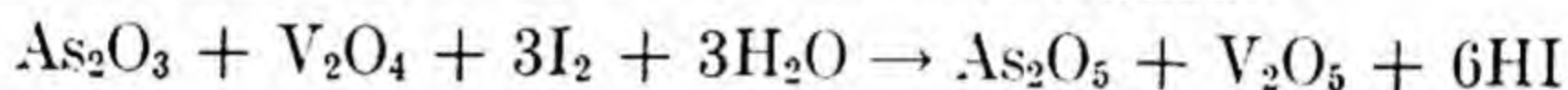
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I-1392

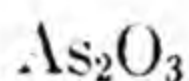


Hydriodic acid is formed when iodine oxidizes arsenic trioxide in the presence of vanadium tetroxide in alkaline solution.



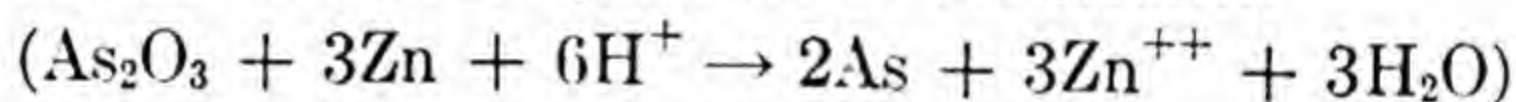
Edgar: Z. anorg. Chem., **61**, 77 (1909)

25



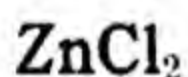
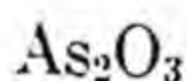
I-1393

Arsenic soluble in carbon disulfide may be obtained by reducing arsenic trioxide with zinc dust in the presence of the solvent.



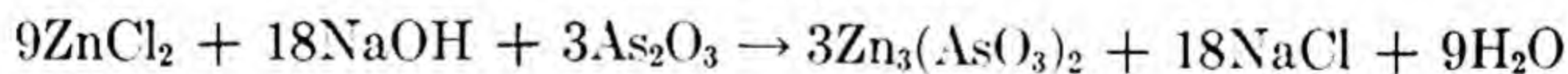
Reginald G. Durrant, J. Chem. Soc. (London), **115**: 1, 135 (1919)

48



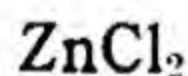
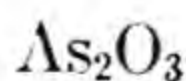
I-1394

Zinc orthoarsenite is formed when arsenic trioxide reacts with zinc chloride in a neutral or alkaline solution.



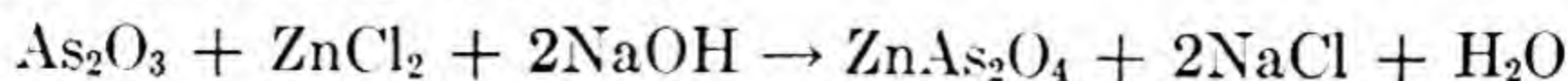
L. P. Curtin, J. Ind. Eng. Chem., **19**, 995 (1927)

23



I-1395

Zinc metarsenite is prepared by adding a solution of arsenic trioxide to a solution of zinc chloride, both slightly acid, and then by adding sodium hydroxide solution to neutrality.

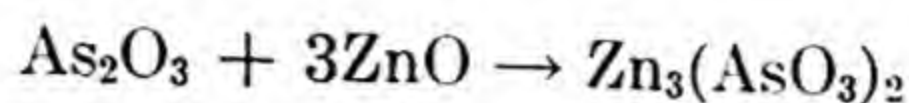


S. Avery, J. Am. Chem. Soc., **28**, 1163 (1906)

Ref., R. C. Roark, J.A.O.A.C., **3**, 336 (1920)

42

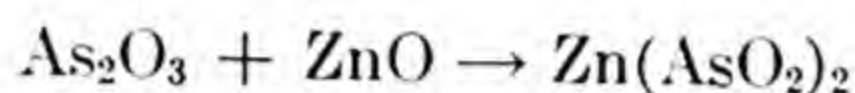
ZnO **I-1396**
 As_2O_3
 Zinc orthoarsenite is formed when a mixture of arsenic trioxide and zinc oxide is heated to 420°.



Kalsing, Z. anorg. Chem., **149**, 68 (1925)

25

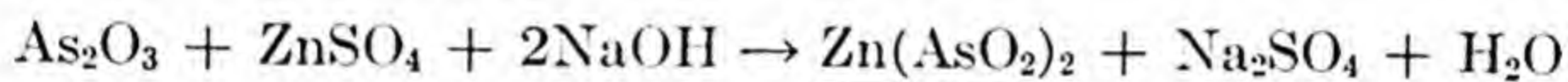
ZnO **I-1397**
 As_2O_3
 Zinc metarsenite is formed when a mixture of arsenic trioxide and zinc oxide is heated to 250°.



Kalsing, Z. Anorg. Chem., **149**, 68 (1925)

25

ZnSO₄ **I-1398**
 As_2O_3
 Zinc arsenite is prepared by adding a solution of arsenic trioxide to a solution of zinc sulfate, both slightly acid, and then neutralizing with sodium hydroxide solution.

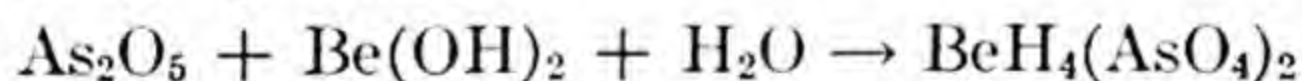


S. Avery, J. Am. Chem. Soc., **28**, 1163 (1906)

Ref., O. B. Winter, J.A.O.A.C., **4**, 135 (1920)

42

Be(OH)₂ **I-1399**
 As_2O_5
 Hygroscopic crystalline leaflets of monoberyllium arsenate are obtained when arsenic pentoxide dissolved in a small quantity of water is treated with pure beryllium hydroxide.



Bleyer and Müller: Z. anorg. Chem., **75**, 287 (1912)

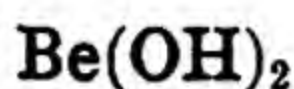
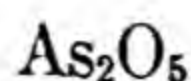
25

Be(OH)₂ **I-1400**
 As_2O_5
 Amorphous beryllium hydrogen arsenate is formed when arsenic pentoxide dissolved in a little water is heated to 220° with pure beryllium hydroxide for several hours.



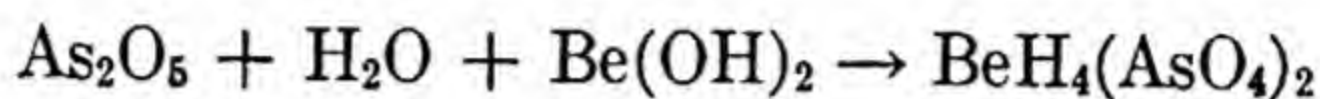
Bleyer and Müller, Z. anorg. Chem., **75**, 287 (1912)

25



I-1401

4.31 grams of beryllium hydroxide are added to a solution of 23 grams of arsenic pentoxide in hot water. By concentrating this solution over concentrated sulfuric acid colorless crystals of monoberyllium hydrogen arsenate are obtained.

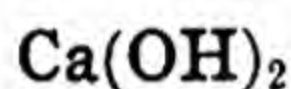
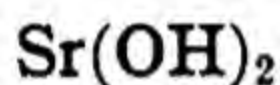
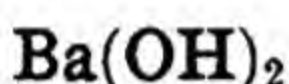


B. Bleyer and Müller, *Z. anorg. Chem.*, **75**, 285 (1912)

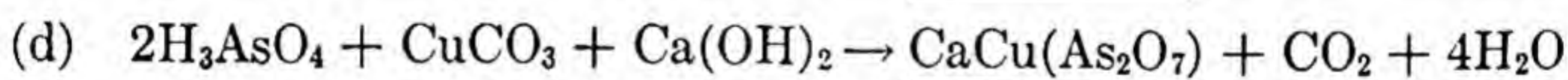
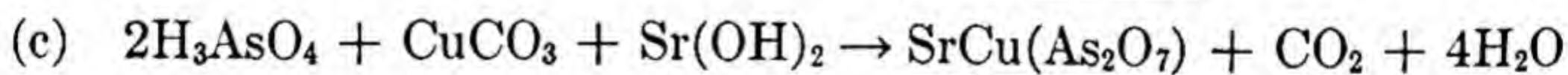
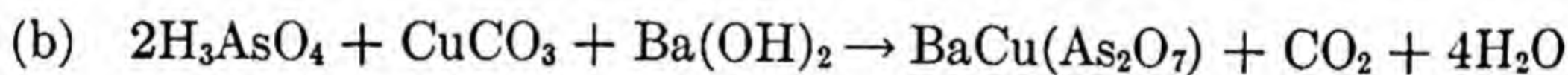
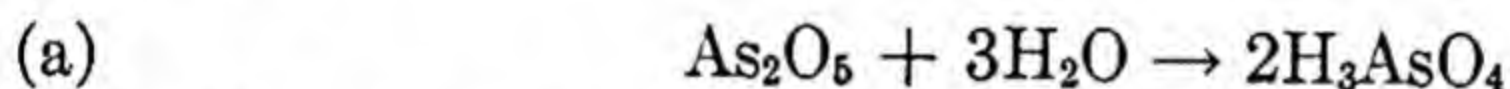
28



I-1402

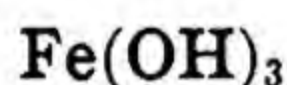
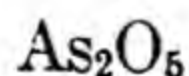


30 grams of arsenic pentoxide are put into a pressure tube and dissolved in 30 ml of water. 1.25 grams of copper carbonate and 9.5 grams of barium hydroxide are added. The sealed tube is heated for 8 hours at a temperature of 180°. Prismatic crystals of a blue greenish color, the barium salt of the copper pyroarsenic acid are obtained. The same type reaction occurs with strontium hydroxide and calcium hydroxide.



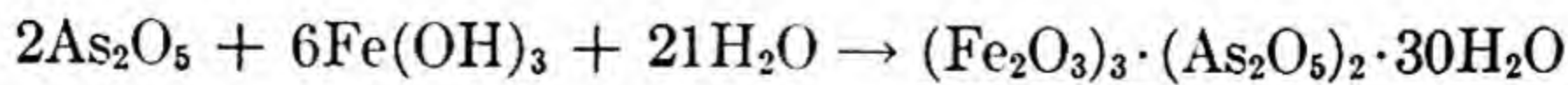
A. Rosenheim and H. Autelmann, *Z. anorg. Chem.*, **187**, 385 (1930)

28



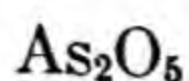
I-1403

By heating, in a sealed tube at 160° for three hours, 7 grams of arsenic pentoxide with 50 ml H₂O and iron hydroxide obtained from 3 grams of ferric chloride, a white precipitate is formed.



A. Rosenheim and S. Thon, *Z. anorg. Chem.*, **167**, 1 (1927)

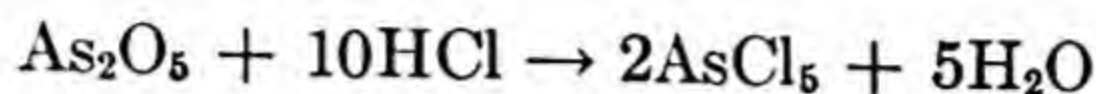
28



HCl

I-1404

Arsenic pentachloride may be formed by the action of an excess of hydrochloric acid upon arsenic pentoxide.



F. Neher: Z. anal. Chem. **32**, 47 (1893)

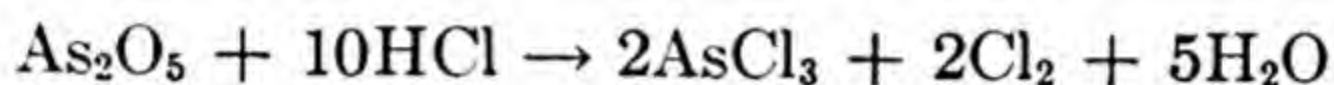
25



HCl

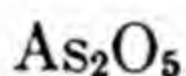
I-1405

When arsenic pentoxide is treated with hydrochloric acid, arsenous trichloride, chlorine and water are produced.



F. L. Usher and M. W. Travers, J. Chem. Soc. (London), **87**, 1372 (1905)

102

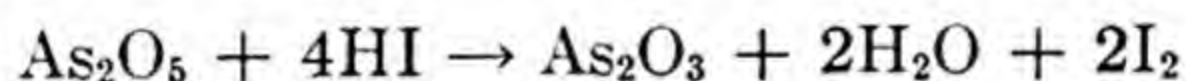


HI

I-1406

Hydriodic acid reduces arsenic pentoxide to arsenic trioxide in the presence of hydrochloric acid in the cold; iodine is formed during this reaction.

The iodine formed can be titrated with thiosulfate solution, thus affording a convenient method for the volumetric estimation of arsenic.



Quasim A. Mansuri, J. Chem. Soc., **123**, 220 (1923)

48

Ref., Halland, J. Ind. Eng. Chem., **3**, 168 (1911)

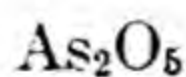
22

Ref., Z. Anal. Chem., **53**, 73 (1914)

25

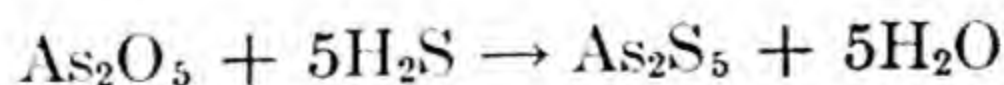
Ref., Little, Cohen, and Morgan, J. Chem. Soc., (London), **95**, 1478 (1909)

103

H₂S

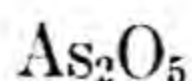
I-1407

Arsenic pentasulfide forms when hydrogen sulfide reacts with arsenic pentoxide.

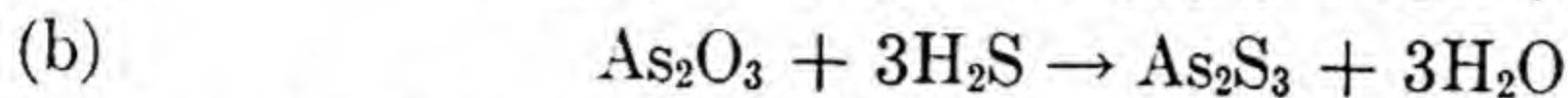
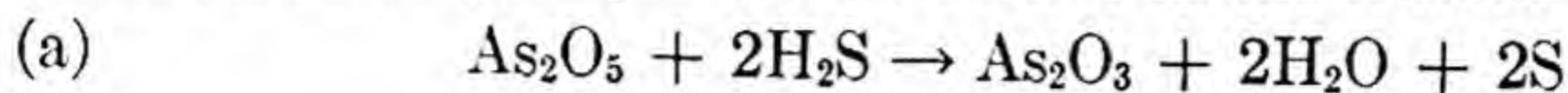


L. Vanino and C. Griebel, Z. anal. Chem. **40**, 589 (1901)

25

**H₂S****I-1408**

Hydrogen sulfide first reduces arsenic pentoxide with the separation of sulfur and then precipitates the arsenic as the trisulfide.



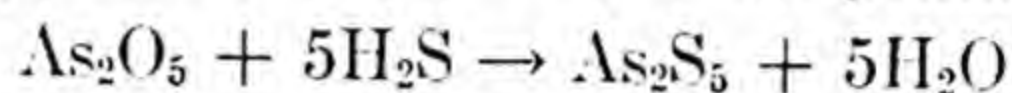
Wachenroder, Luding and H. Rose, *Ann. der phys. u. chem.*, **107**, 186

Ref., L. W. McCay, *Am. Chem. J.*, **10**, 459 (1888)

Ref., F. L. Usher and M. W. Travers, *J. Chem. Soc. (London)*, **87**, 1371 (1905) 17
102

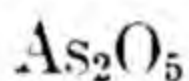
**H₂S****I-1409**

When a current of hydrogen sulfide in excess is passed into an acidulated solution of arsenic pentoxide kept at 70°C the pentasulfide is formed.

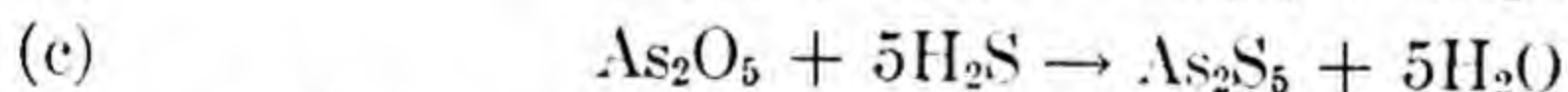
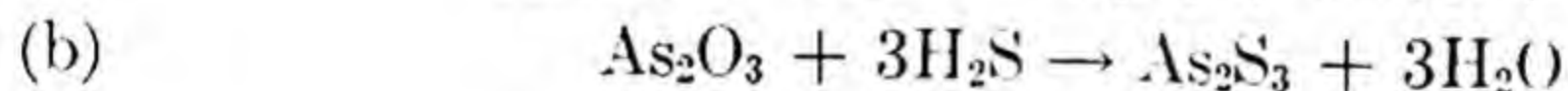
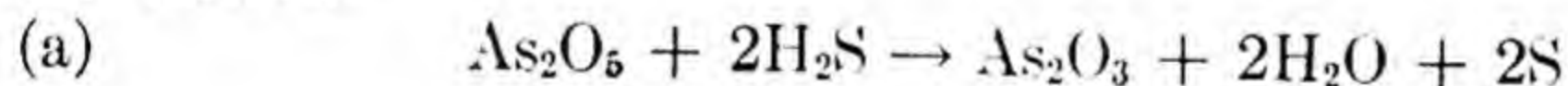


Lerry W. McCay, *Am. Chem. J.*, **10**, 459 (1888)

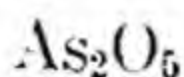
Ref., F. L. Usher and M. W. Travers, *J. Chem. Soc., (London)* **87**, 1371 (1905) 17
102

**H₂S****I-1410****HCl**

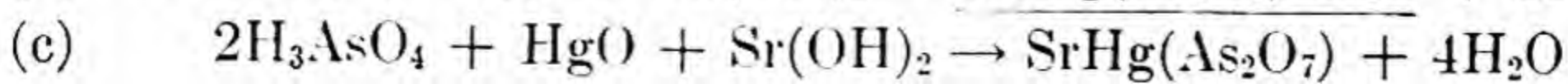
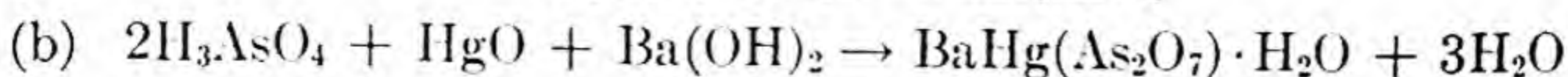
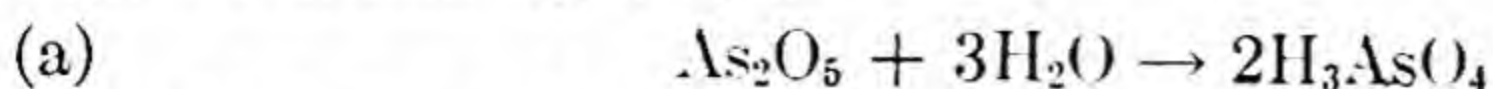
If hydrogen sulfide is passed through a solution of arsenic pentoxide which is acidified slightly with hydrochloric acid the reaction to the sulfide takes place in two steps. Both arsenious and arsenic sulfides are formed.

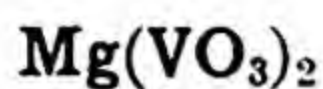
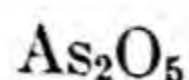


Usher and Travers, *J. Chem. Soc., London*, **87**, Pt. 2, 1371 (1905) 103

**HgO****I-1411****Ba(OH)₂****Sr(OH)₂**

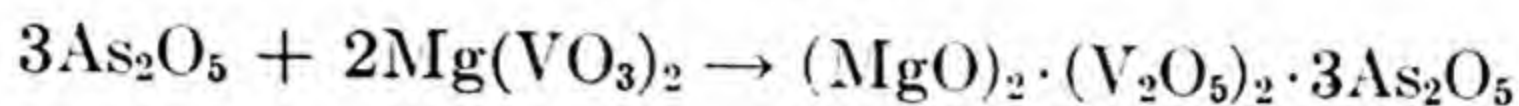
In a glass pressure tube 30 grams of arsenic pentoxide are dissolved in 45 cc of water; 2.2 grams of mercuric oxide and 9.5 grams of barium hydroxide are added. The sealed tube is kept at a temperature of 180°–200° for 5 hours. Crystals of yellow color, composed of barium mercuric pyroarsenate are obtained. The same type reaction occurs with strontium hydroxide.





I-1412

Magnesium vanadium arsenate is obtained when magnesium metavanadate reacts with arsenic pentoxide.



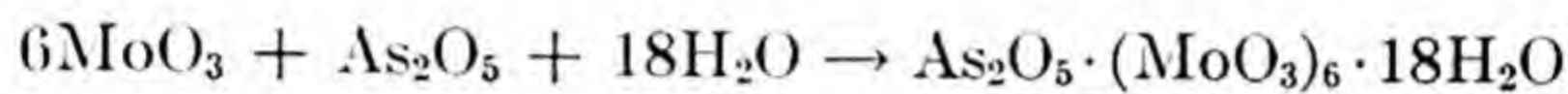
C. Friedheim: Ber. **23**, 2600 (1890)

25



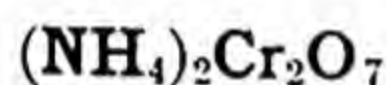
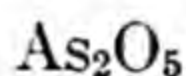
I-1413

Colorless crystals are obtained by boiling a solution of molybdenum trioxide with arsenic acid.



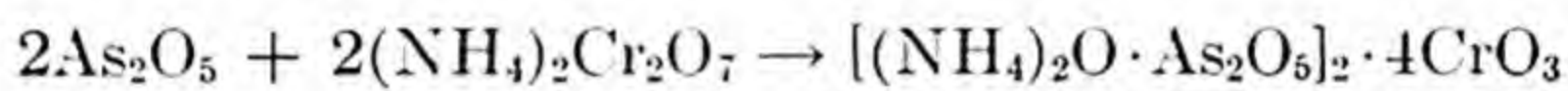
C. Friedheim, Z. anorg. Chem., **2**, 314 (1892)

28



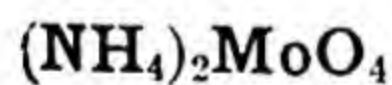
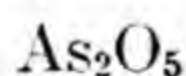
I-1414

Arsenic pentoxide will react with a concentrated solution of ammonium dichromate yielding red crystals.



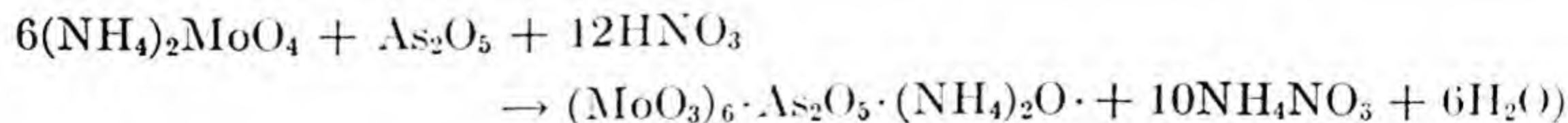
C. Friedheim, Z. anorg. Chem. **6**, 273 (1894)

28



I-1415

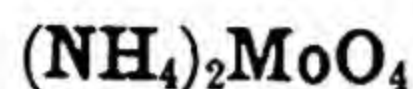
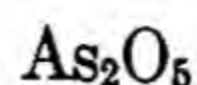
When the calculated amount of arsenic pentoxide is added to a nitric acid solution of ammonium molybdate and the solution evaporated at a temperature not exceeding 50–60°C., an ammonium arseno molybdate is formed.



H. Debray,

Ref., A. Henninger, Ber., **7**, 820 (1874)

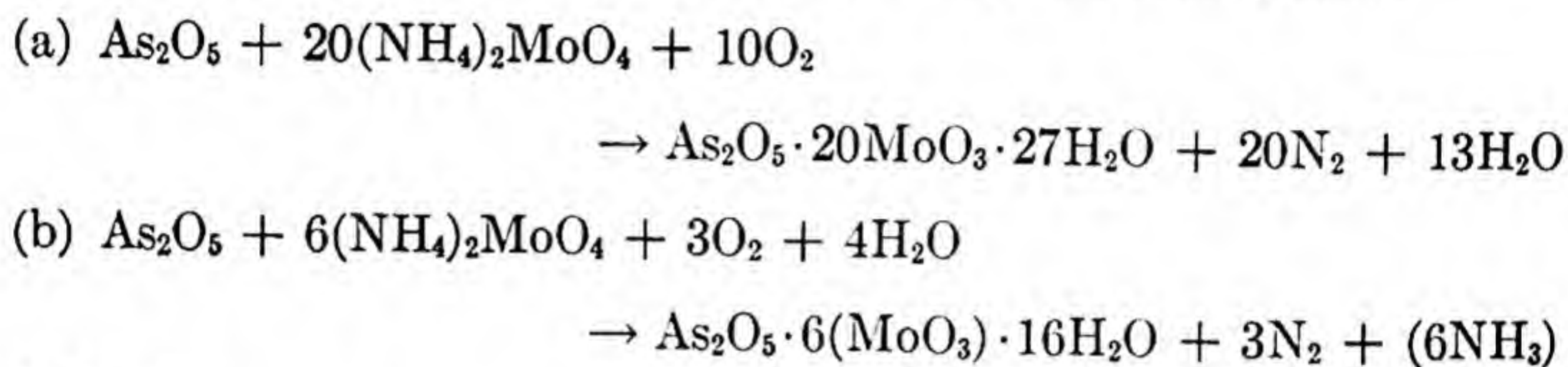
26



I-1416

aqua regia

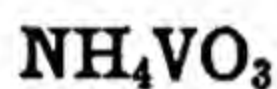
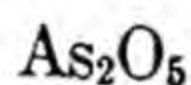
When a strong nitric acid solution of ammonium molybdate which contains a little arsenic pentoxide is boiled with aqua regia until all of the ammonia is destroyed, two complex arseno molybdic acids crystallize out when the reaction product is allowed to stand. The two acids may be separated mechanically; one is white, the other yellow.



H. Debray,

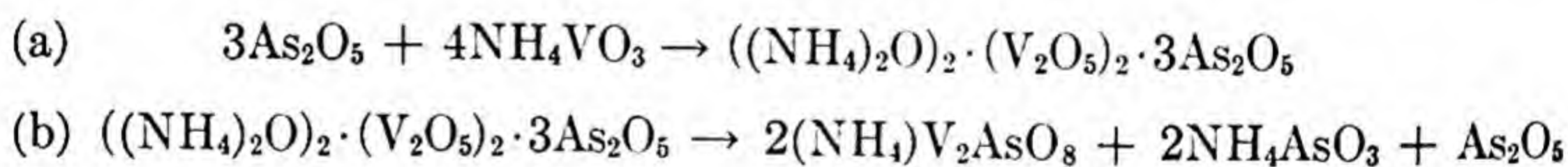
Ref., A. Henninger, Ber., 7, 819 (1874)

11



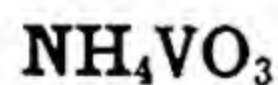
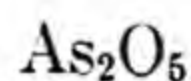
I-1417

An ammonium vanadium arsenate is formed when arsenic pentoxide reacts with ammonium metavanadate. This compound is unstable and breaks down into ammonium metarsenate.



C. Friedheim, Ber. 23, 2600 (1890)

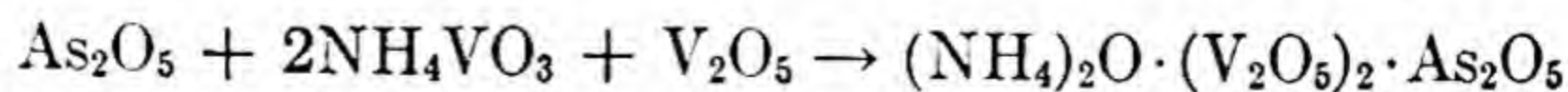
25



I-1418



A double compound is obtained when arsenic pentoxide is allowed to react with ammonium metavanadate and vanadium pentoxide.

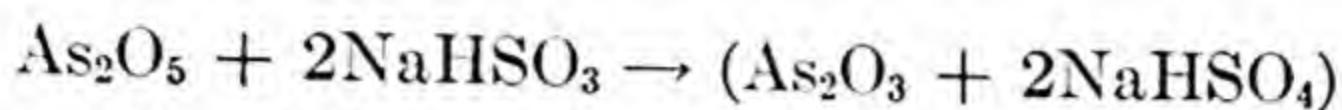


C. Friedheim, Ber., 23, 2600 (1890)

25

**NaHSO₃****I-1419**

The influence of temperature and concentration of sulfuric acid and sodium hydrogen sulfite on the reduction of arsenic pentoxide has been studied.



Pett, Biochem. J., **27**, 1672-6, (1933)

Ref., Zinzode, Anal. Ed., **7**, 227-8 (1935)

Ref., Tschopp and Tschopp, Helv. Chim. Acta, **15**, 1023 (1932)

Ref., Tononief and Potschinok, Z. Anal. Chem. **88**, 271 (1932)

33

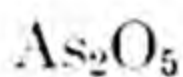
**PCl₅****I-1420**

Arsenic trichloride and phosphorus oxychloride are obtained along with the evolution of chlorine, when arsenic pentoxide is treated with phosphorus pentachloride.

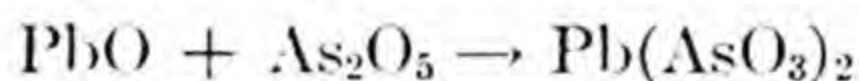


Hurtzig and Geuther, Ann. **111**, 173 (1859)

25

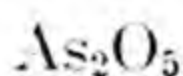
**PbO****I-1421**

Lead metarsenate is formed when a mixture of lead oxide and solid arsenic pentoxide in correct proportions is heated to dull redness.



McDonnell and Smith, J. Am. Chem. Soc., **38**, 2035 (1916)

1

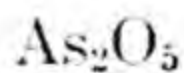
**Pb₃O₄****I-1422**

Lead metarsenate is produced when a mixture of red lead and solid arsenic acid in the proper proportion is fused at dull red heat.

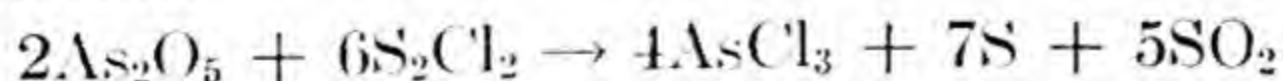


McDonnell and Smith, J. Am. Chem. Soc., **38**, 2035 (1916)

1

**S₂Cl₂****I-1423**

Arsenic trichloride is formed when arsenic pentoxide is heated with sulfur monochloride.



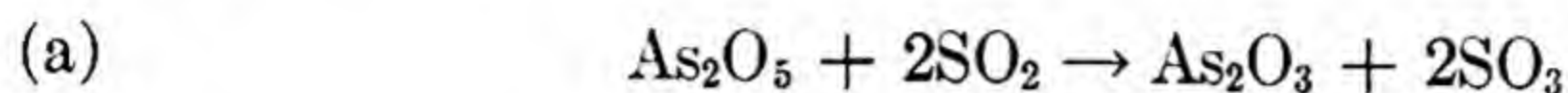
Prinz: Ann. **223**, 359 (1884)

25


 SO_2

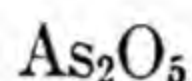
I-1424

The poisoning of catalysts in the contact process for sulfuric acid starts at about 300°C., whereas the maximum catalytic efficiency starts at 660°C. The reactions involved in the poisoning may be written as follows:



B. Neumann and H. Jüttner, *Z. Elektrochem.*, **36**, 95 (1930)

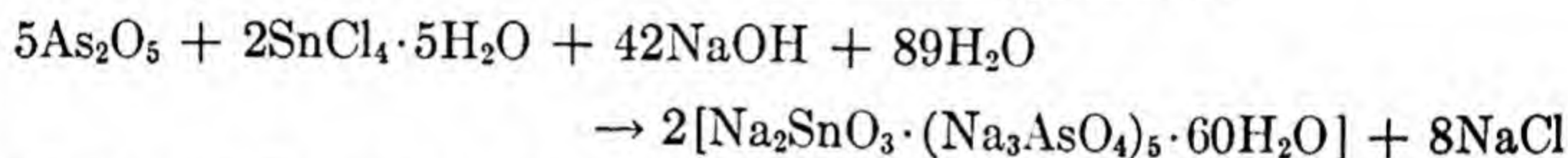
86


 $\text{SnCl}_4 \cdot 5\text{H}_2\text{O}$

I-1425

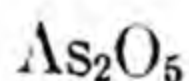
 NaOH

Colorless needle-like crystals of sodium stannate-arsenate are obtained when a mixture of a solution of stannic chloride pentahydrate and arsenic pentoxide is neutralized with sodium hydroxide.



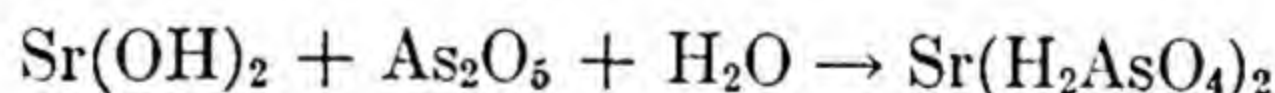
W. Prandtl, *Ber.*, **40**, 2133 (1907)

25


 $\text{Sr}(\text{OH})_2$

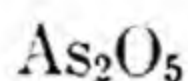
I-1426

Strontium dihydrogen arsenate is formed when strontium hydroxide is added to a solution of arsenic pentoxide.



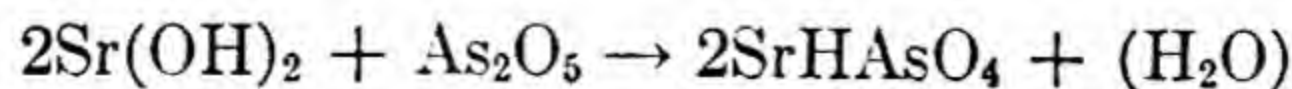
Tartar, Rice and Sweo, *J. Am. Chem. Soc.*, **53**, 3950 (1931)

25


 $\text{Sr}(\text{OH})_2$

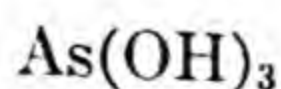
I-1427

Strontium hydrogen arsenate is prepared when solid strontium hydroxide is added to a solution of arsenic pentoxide and sodium hydroxide added until pH of 5.4 is reached.

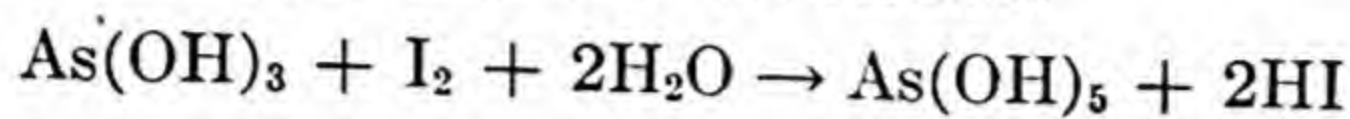


Tartar, Rice and Sweo, *J. Am. Chem. Soc.*, **53**, 3950 (1931)

1

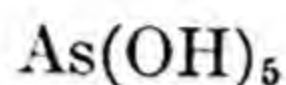
**I₂****I-1428**

When arsenious acid is treated with iodine and water, arsenic pentahydroxide and hydriodic acid are formed.

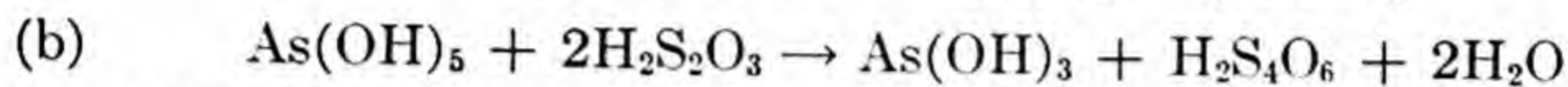
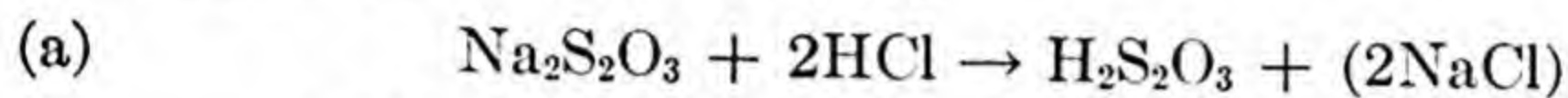


R. M. Chapin, J. Agr. Res., **1**, 515, (1914)

67

**H₂S₂O₃****I-1429**

Sodium thiosulfate in a solution of hydrochloric acid forms thiosulfuric acid (a), which reduces arsenic pentahydroxide to arsenious acid and is oxidized to tetrathionic acid, (b).

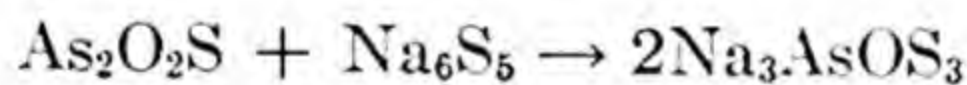


R. M. Chapin, J. Agr. Res., **1**, 517 (1914)

67

**Na₆S₅****I-1430**

Sodium trithioarsenate can be obtained by the action of sodium polysulfide on arsenic dioxysulfide (prepared by: $2\text{As}_2\text{O}_3 + \text{As}_2\text{S}_3 \rightarrow 3\text{As}_2\text{O}_2\text{S}$).

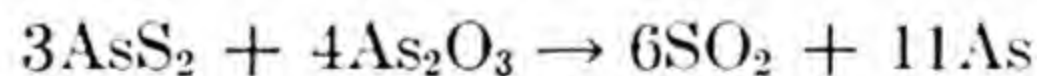


Weinland and Rumpf, Ber., **29**, 1008 (1896)

25

**As₂O₃****I-1431**

In the presence of an excess of arsenic trioxide arsenic disulfide will be transformed into sulfur dioxide and metallic arsenic.

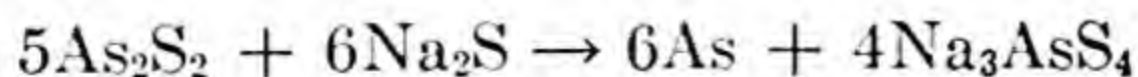


Nilson, Gazz. Chim. Ital., **7**, 242 (1877)

21

**Na₂S****I-1432**

Sodium thioarsenate and arsenic are formed when realgar is treated with sodium sulfide.



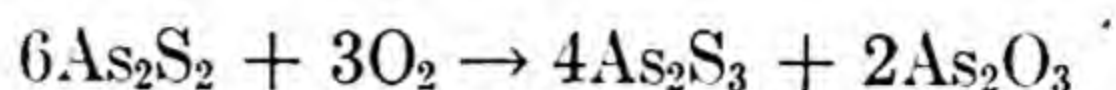
A. Geuther: Ann. **240**, 208 (1887)

25

O₂

I-1433

Arsenic disulfide in the presence of air is oxidized to arsenic trisulfide and arsenic trioxide.



Nilson, Gazz. Chim. Ital., 7, 243 (1877)

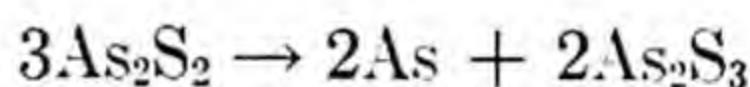
21



Δ

I-1434

Arsenic disulfide heated with alkaline hydrates is transformed into metallic arsenic and arsenic sulfide.



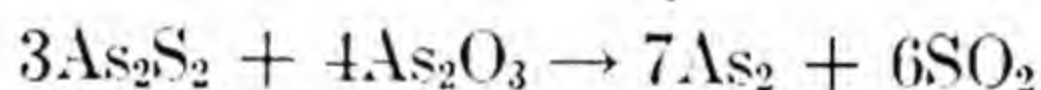
Nilson, Gazz. Chim. Ital. 7, 243 (1877)

21

As₂O₃

I-1435

Arsenic disulfide and arsenic trioxide when heated in a distillation apparatus produce a mirror of crystalline metallic arsenic, while sulfur dioxide is evolved.



L. F. Nilson, K. Sv. Vet. Akad. Handl. 10, 8 (1871)

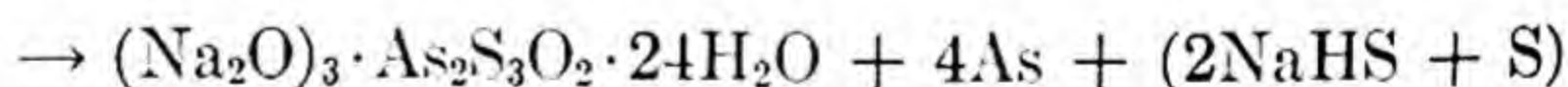
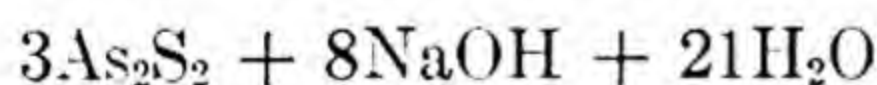
10



NaOH

I-1436

A neutral salt is obtained, along with some arsenic when finely powdered realgar is treated with an excess of sodium hydroxide solution.



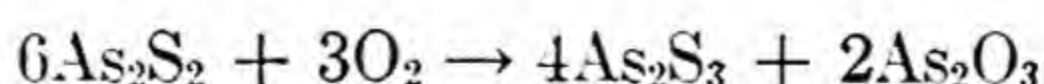
Geuther, Ann. 240, 223 (1886)

1

O₂

I-1437

Arsenic disulfide heated in the presence of oxygen produces arsenic trisulfide and arsenic trioxide.



L. F. Nilson, K. Sv. Vet. Akad. Handl. 10, 82 (1871)

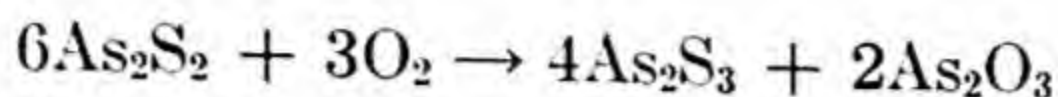
10



Air

I-1438

Arsenic disulfide is decomposed by air to form arsenic trisulfide and arsenic trioxide.



Otto Pettersson, *J. Chem. Soc. (London)* **77**, 1283 (1900)

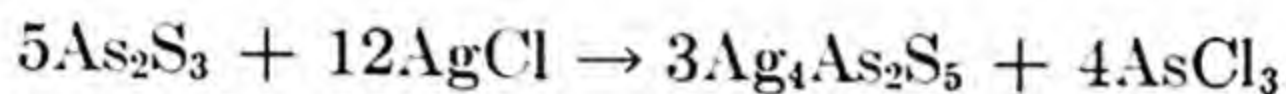
102



AgCl

I-1439

Silver pyrothioarsenite is formed when arsenic trisulfide is heated with silver chloride.



Sommerlad, *Z. anorg. Chem.*, **18**, 420 (1898)

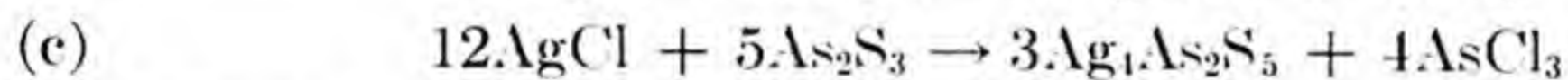
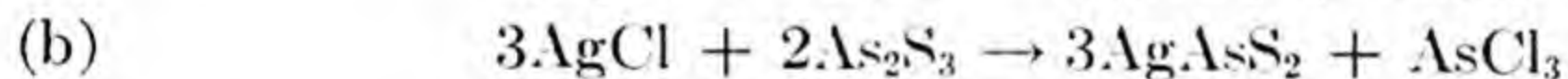
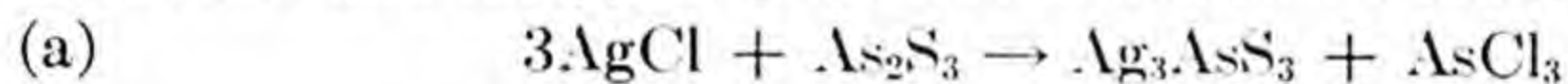
1



AgCl

I-1440

By heating in a retort to 150° , molecular quantities of arsenic trisulfide and silver chloride, excluding air, the sulfide being in slight excess, silver thioarsenite (proustite) is obtained as a dark-red glistening mass, (a). When the amounts of the reactants are varied both the meta, (b), and the pyro, (c), silver arsenites are obtained.



H. Sommerlad, *Z. anorg. Chem.*, **15**, 173 (1897)

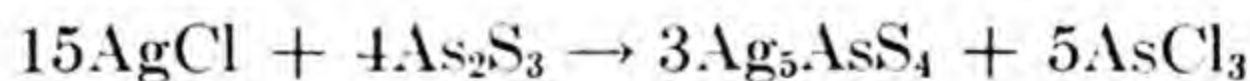
25



AgCl

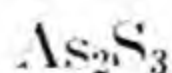
I-1441

By heating a mixture of silver chloride and arsenic trisulfide silver thioarsenite is obtained.



H. Sommerlad, *Z. anorg. Chem.*, **18**, 420 (1898)

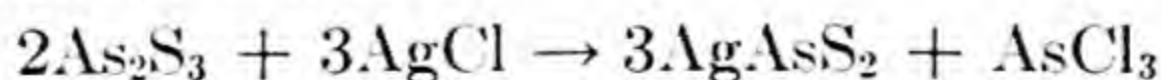
28



AgCl

I-1442

Silver metathioarsenite is obtained when arsenic trisulfide is heated with silver chloride at 170° .

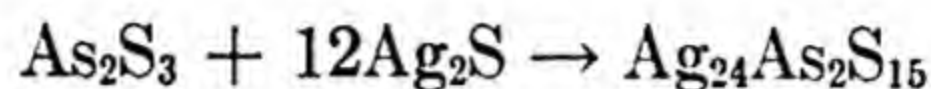


Sommerlad: *Z. anorg. Chem.* **18**, 420 (1898)

25

**Ag₂S****I-1443**

A dull black product is obtained when silver sulfide is melted with arsenic trisulfide.



Sommerlad: Z. anorg. Chem., **18**, 420 (1898)

25

**AsI₃****I-1444**

Crystalline needles are obtained when arsenic trisulfide is melted with an excess of arsenic triiodide in the absence of air.



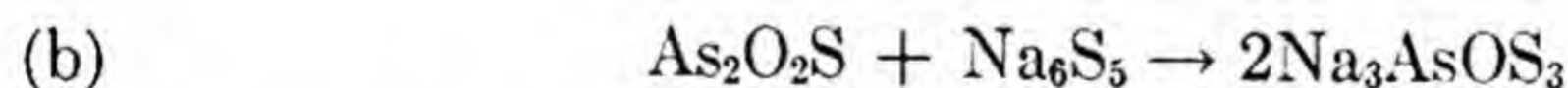
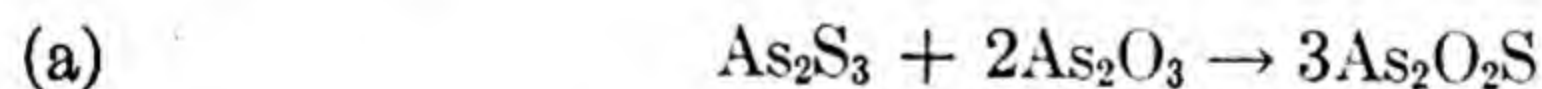
L. Ouvrard: Compt. rend. **117**, 107

Ref., Ber., **26**, 672 (1893)

25

**As₂O₃****I-1445****Na₆S₅**

Sodium trithioarsenate can be obtained by treating with sodium polysulfide the product resulting from melting arsenic trisulfide with arsenic trioxide.

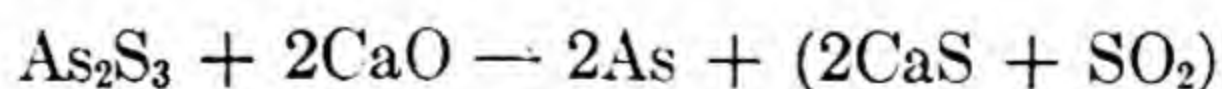


Weinland and Rumpf: Ber., **29**, 1008 (1896)

25

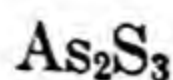
**CaO****I-1446**

Elementary arsenic is produced when arsenic trisulfide vapors are passed through glowing calcium oxide.

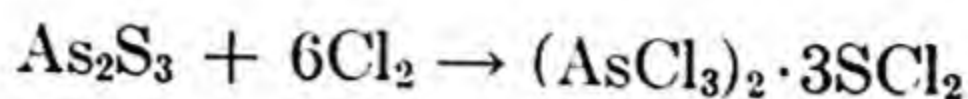


Simon, Ann., **23**, 272 (1837)

1

**Cl₂****I-1447**

A brown liquid was obtained by the action of chlorine on arsenic trisulfide.



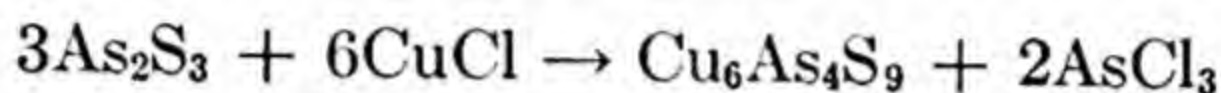
Rose, Pogg. Ann., **42**, 517 (1837)

Ref., J. Chem. Soc. (London), p. 2577 (1929)

1

**CuCl****I-1448**

A black mass of "binnite" is formed when arsenic trisulfide and cuprous chloride are heated together at 200°–300°.

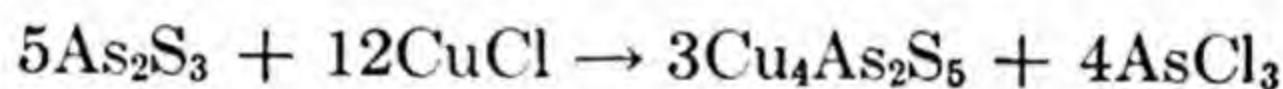


Sommerlad: Z. anorg. Chem. **18**, 420 (1898)

25

**CuCl****I-1449**

A copper compound of arsenic and sulfur is formed when arsenic trisulfide and cuprous chloride are heated together.

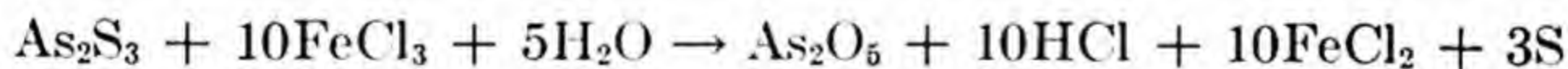


Sommerlad: Z. anorg. Chem. **18**, 420, (1898)

25

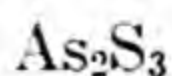
**FeCl₃****I-1450**

Arsenic pentoxide is formed when arsenic trisulfide reacts with ferric chloride in solution.

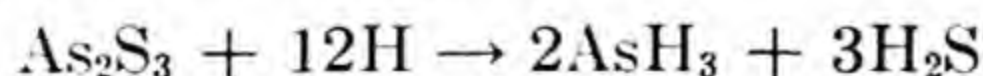


Cammerer: Berg u. Hüttenmänn Ztg. (1891) pp. 203, 261

25

**H****I-1451**

Arsine and hydrogen sulfide are formed when nascent hydrogen reduces freshly precipitated arsenic trisulfide.



R. Otto, Ber., **16**, 2947 (1883)

25



HCOONa

I-1452

Arsine is formed when a mixture of sodium formate and arsenic trisulfide is heated to redness.



Vournasos: Ber. **43**, 2264 (1910)

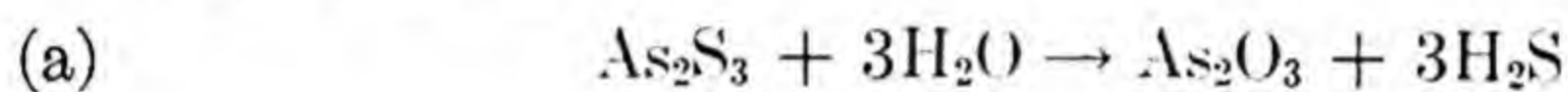
25

H₂O

I-1453

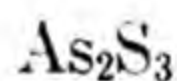
O₂

Oxygen under pressure will hydrolyze a suspension of arsenic trisulfide in water to arsenic trioxide and hydrogen sulfide. The latter will be oxidized to sulfuric acid.



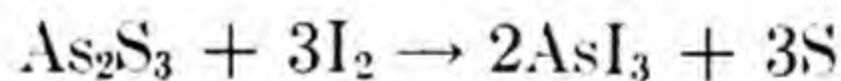
H. Zieler, Z. anorg. Chem., **162**, 161 (1927)

28

I₂

I-1454

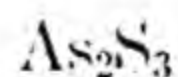
Arsenic triiodide and free sulfur are obtained when iodine decomposes arsenic trisulfide.



R. Schneider: J. prakt. Chem., (2), **36**, 498

Ref., Ber., **21**, 169 (1888)

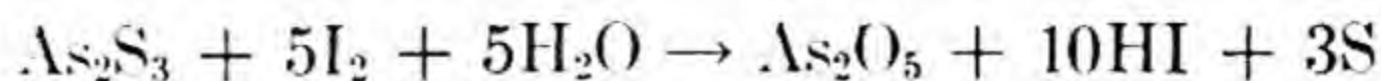
25

I₂

I-1455

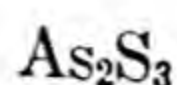
H₂O

To a suspension of arsenic trisulfide in water is added sodium carbonate, a little starch paste and a standard solution of iodine. The arsenic trisulfide should be absolutely free from hydrogen sulfide.



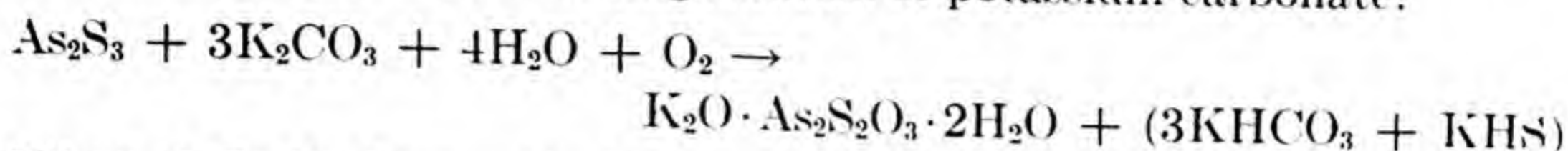
M. Graebe, Chem. News, **1**, 106 (1867)

101



I-1456

Crystals of potassium oxythioarsenate are obtained when arsenic trisulfide is treated with a boiling solution of potassium carbonate.



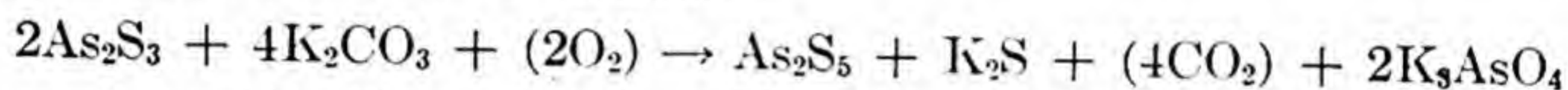
Nilson, J. Prakt. Chem., (2), **14**, 21
Ref., Ann., **257**, 178 (1890)

1



I-1457

Arsenic pentasulfide is formed when a mixture of arsenic trisulfide and potassium carbonate is melted.



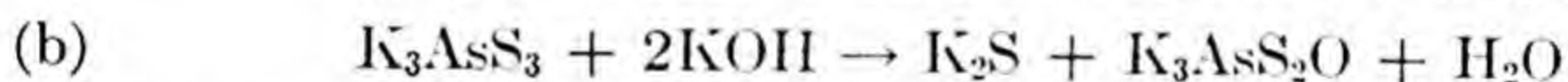
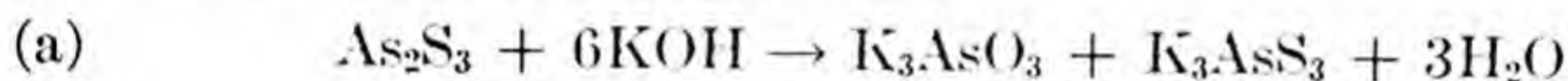
Rose, Pogg. Ann. **90**, 565
Ref., Ann., **88**, 401 (1853)

1



I-1458

Arsenic trisulfide dissolves in an excess of potassium hydroxide forming potassium sulfide and dithioarsenite.



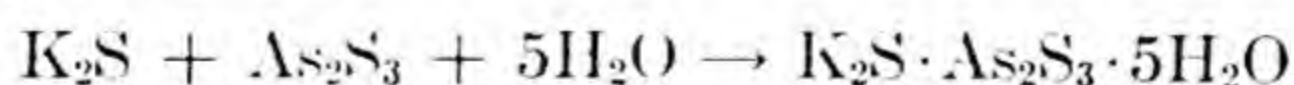
Curtman and Marcus, J. Am. Chem. Soc., **36**, 1097 (1914)

1



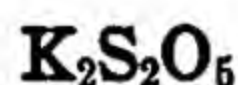
I-1459

When arsenic trisulfide is dissolved in a solution of potassium sulfide, with or without the presence of hydrogen sulfide, potassium sulfarsenide is formed, containing five molecules of water of hydration. Solutions of sulfides of sodium, ammonium, barium, strontium, calcium, and magnesium behave similarly to that of potassium, but best in the presence of hydrogen sulfide.



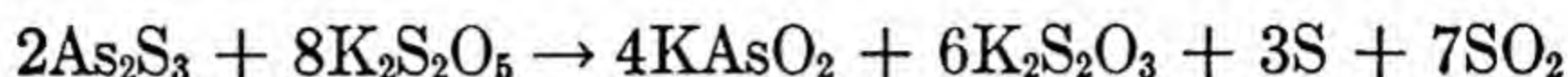
L. F. Nilson, K. Sv. Vet. Akad. Handl. **10**, 44-67 (1871)

10



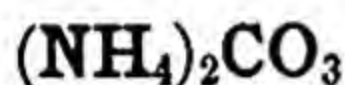
I-1460

Potassium metarsenite is formed when arsenic trisulfide reacts with potassium pyrosulfite.



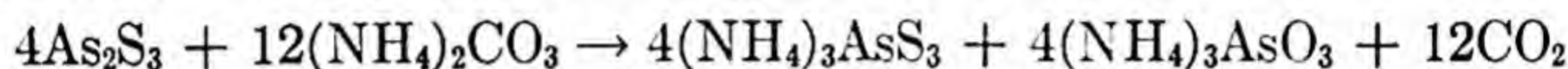
R. Bunsen: *Ann.* **192**, 305 (1878)

25



I-1461

Ammonium thioarsenite and ammonium arsenite are formed when ammonium carbonate reacts with arsenic trisulfide.



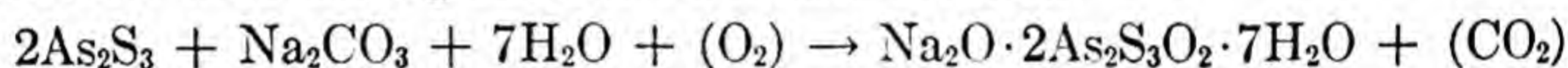
L. Vanino and C. Griebel: *Z. anal. Chem.* **40**, 589 (1901)

25



I-1462

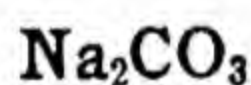
Six-sided crystalline tablets are obtained when arsenic trisulfide is treated with boiling sodium carbonate solution.



Nilson, *J. prakt. Chem.*, (2) **14**, 12

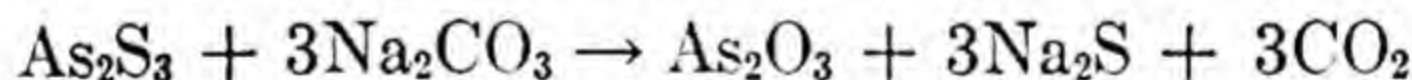
Ref., *Ann.*, **257**, 179, (1890)

1



I-1463

Arsenic trisulfide dissolves in sodium carbonate solution evolving carbon dioxide and leaving sodium sulfide and arsenic oxide in solution.



P. Klason, *Ark. Kem., Min., Geol.*, **6**, Part 5, 12 (1916)

Ref., *J. Chem. Soc. (London)*, **112**, 152 (1917)

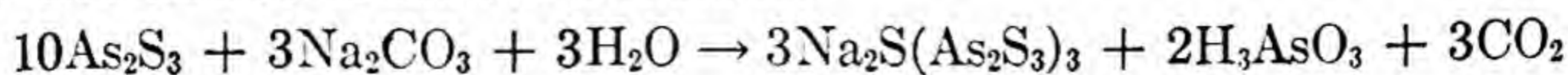
10

1



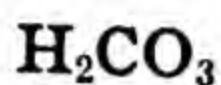
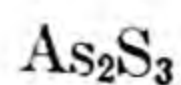
I-1464

When arsenic trisulfide is dissolved in boiling concentrated sodium carbonate solution sodium sulfarsenide is the main product formed, mixed with other more complex compounds containing sodium, arsenic and sulfur. A similar reaction takes place when potassium carbonate is used instead of sodium carbonate.



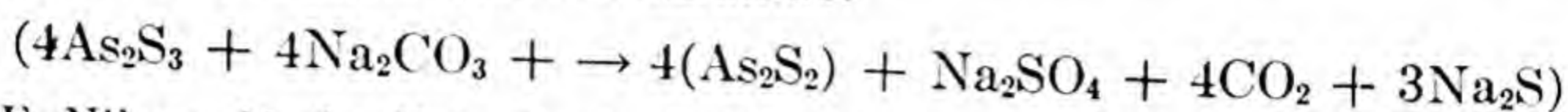
L. F. Nilson, *K. Sv. Vet. Akad. Handl.* **10**, 36 (1871)

10



I-1465

Arsenious sulfide heated with sodium carbonate in the presence of carbonic acid produces arsenic disulfide.

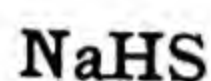
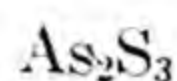


L. F. Nilson, K. Sv. Vet. Akad. Handl., **10**, 36 (1871)

Ref., Senarmont, Ann. chim. Phys., **33**, 129

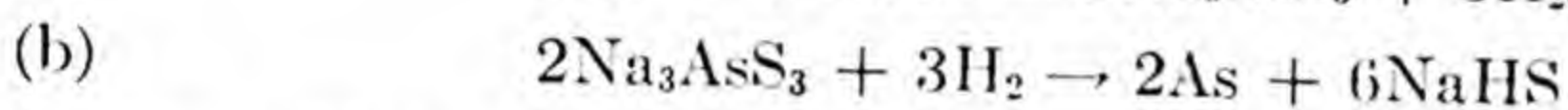
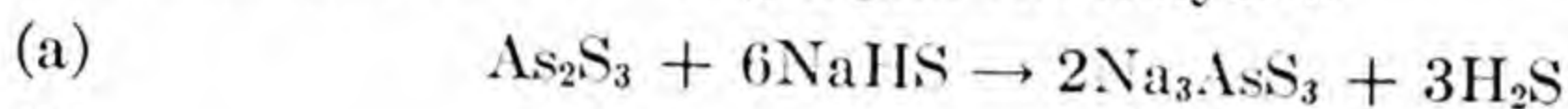
Ann. **80**, 218 (1851); and Rose: Ann. der Phys. u. Chem., **90**, 566

10



I-1466

Arsenic is formed when sodium hydrogen sulfide reacts with arsenic trisulfide and the resulting liquid electrolyzed.



Siemens, Brit. Pat. 7123 (1896)

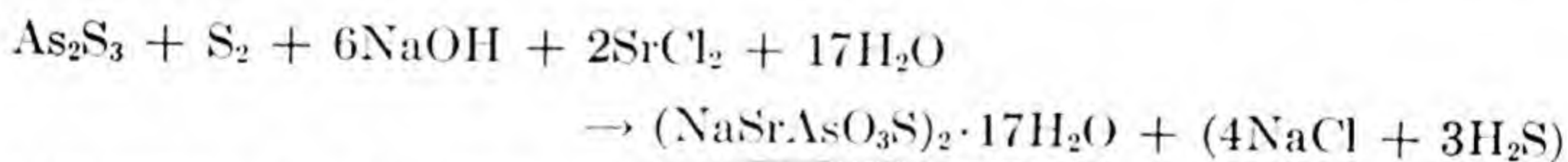
26



I-1467



Sodium-strontium monothioarsenate is obtained when arsenic trisulfide moistened with alcohol is rubbed with sodium hydroxide, treated with water and then strontium chloride added until precipitation is complete.



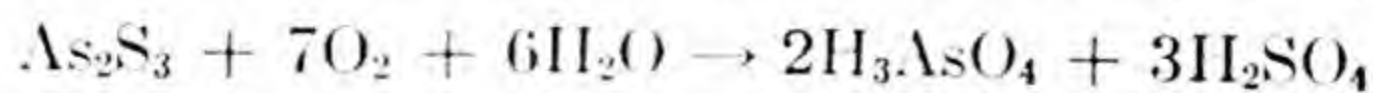
McLauchlan: Ber. **34**, 2166 (1901)

25



I-1468

Oxygen under pressure will react with a suspension of arsenic trisulfide in 40%-60% nitric acid yielding arsenic acid and sulfuric acid.



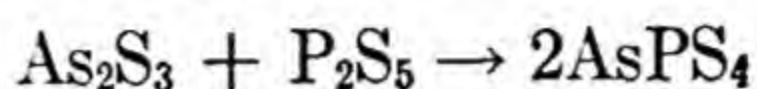
H. Zieler, Z. anorg. Chem., **162**, 161 (1927)

28



I-1469

Arsenic thiophosphate of yellow green color is obtained when a mixture of arsenic trisulfide and phosphorus pentasulfide is heated.



E. Glatzel, *Z. anorg. Chem.*, **4**, 186 (1893)

28

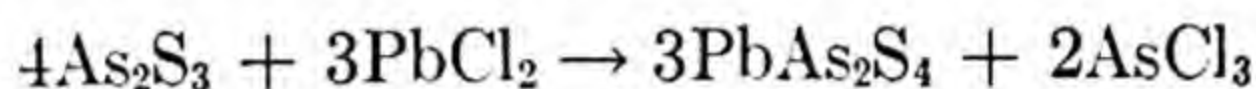
Ref., *Ber.*, **26**, 577 (1893)

25



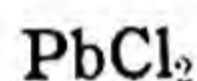
I-1470

Reddish-brown arsenic sulfide-lead sulfide is obtained when a mixture of arsenic trisulfide and lead chloride is heated.



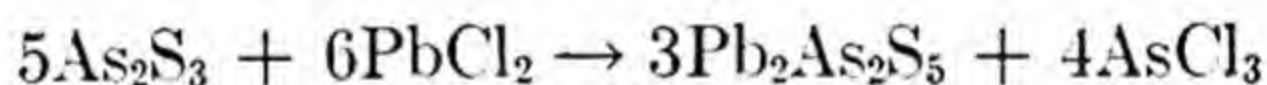
Sommerlad, *Z. anorg. Chem.*, **18**, 420 (1898)

25



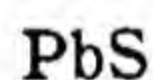
I-1471

A bright steel-gray lustrous "dufrenoyite" is obtained when a mixture of arsenic trisulfide and lead chloride is heated to a high temperature.



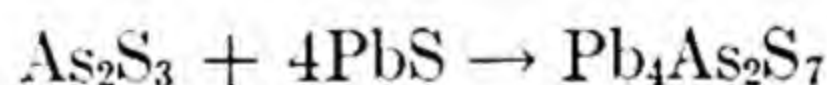
Sommerlad: *Z. anorg. Chem.*, **18**, 420 (1898)

28



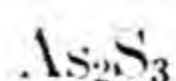
I-1472

"Jordanite" is formed when a mixture of lead sulfide and arsenic trisulfide is heated.



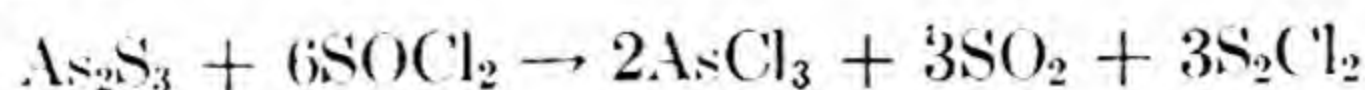
Sommerlad: *Z. anorg. Chem.*, **18**, 420 (1898)

28



I-1473

Arsenic trichloride results when arsenic trisulfide reacts with thionyl chloride at 150°.



North and Conover, *J. Am. Chem. Soc.*, **17**, 2488 (1915)

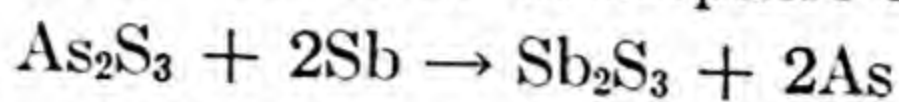
1

Sb



I-1474

Antimony trisulfide is obtained when a mixture of dry arsenic trisulfide and antimony is heated to 260° in an atmosphere of carbon dioxide.



Krafft and Neuman: Ber. **34**, 565 (1901)

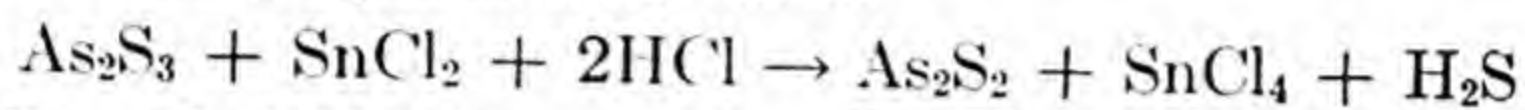
25

SnCl₂

I-1475

HCl

Arsenic disulfide is precipitated when a hydrochloric acid solution of stannous chloride reduces freshly precipitated arsenic trisulfide in the presence of fuming hydrochloric acid.



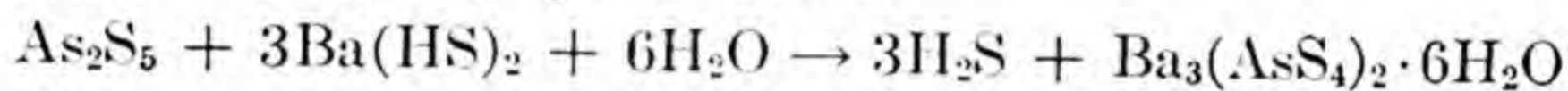
Chrenfeld: Ber., **40**, 3962 (1907)

25

Ba(HS)₂

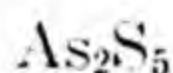
I-1476

Barium orthothioarsenate is formed when a solution of barium hydrosulfide reacts with arsenic pentasulfide.



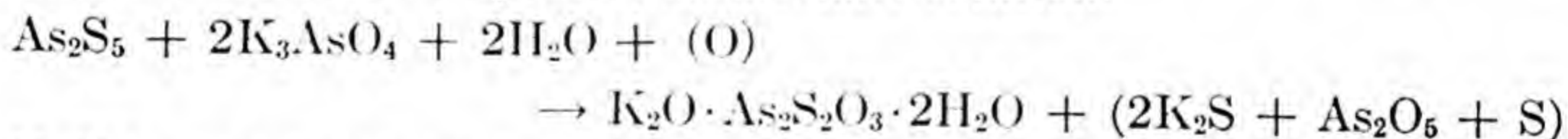
Glatzel: Z. anorg. Chem., **71**, 209 (1911)

25

K₃AsO₄

I-1477

Crystals of potassium oxythioarsenate are obtained when arsenic pentasulfide is dissolved in potassium arsenate solution.



H. Nilson, J. prakt. Chem., (2), **14**, 21

Ref., K. Preis, Ann. **257**, 178 (1890)

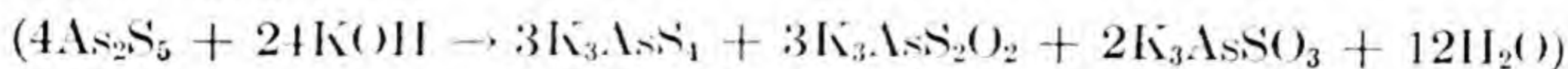
25

KOH



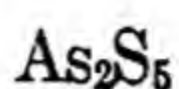
I-1478

Arsenic pentasulfide will react with potassium hydroxide yielding potassium thioarsenate, potassium dithioarsenate and potassium monothioarsenate.

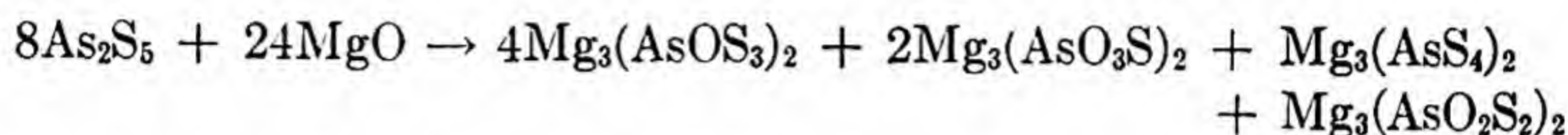


R. F. Weinland and P. Lehmann, Z. anorg. Chem. **26**, 322 (1901)

28

**MgO****I-1479**

A mixture of magnesium mono and trithioarsenates and magnesium thioarsenate is formed when freshly prepared arsenic pentasulfide is allowed to react with magnesium oxide suspended in water.



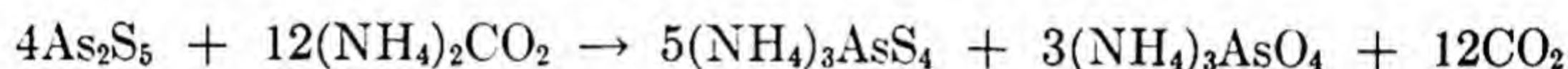
McCay and Foster: *Z. anorg. Chem.*, **41**, 452 (1904)

Ref., *Ber.*, **37**, 573 (1904)

1

**(NH₄)₂CO₃****I-1480**

Ammonium thioarsenate and ammonium arsenate are formed when ammonium carbonate reacts with arsenic pentasulfide.

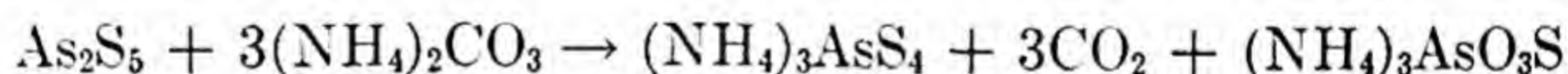


L. Vanino and C. Griebel: *Z. anal. Chem.*, **40**, 589 (1901)

25

**(NH₄)₂CO₃****I-1481**

Ammonium thioarsenate and ammonium monothioarsenate are formed when ammonium carbonate reacts with arsenic pentasulfide.

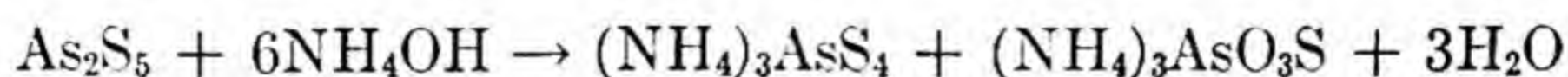


Weinland: *Z. anal. Chem.*, **40**, 589 (1901)

25

**NH₄OH****I-1482**

A solution containing ammonium thioarsenate and ammonium monothioarsenate is obtained when arsenic pentasulfide is treated with ammonium hydroxide.



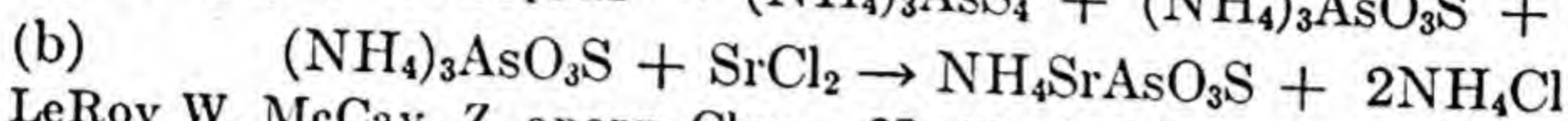
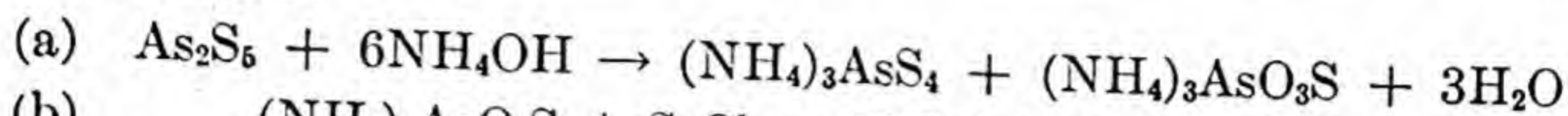
McCay: *Ber.* **32**, 2471 (1899)

Ref., *Chem. Ztg.* **15**, 476

25

NH₄OHAs₂S₅**SrCl₂****I-1483**

Arsenic pentasulfide is soluble in the most concentrated solution of ammonium hydroxide. This solution will react with a solution of strontium chloride yielding crystals of ammonium strontium monothioarsenate.

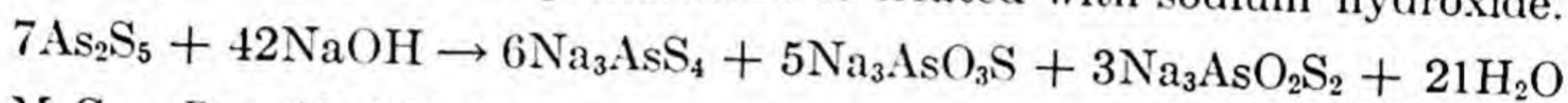


LeRoy W. McCay, *Z. anorg. Chem.*, **25**, 459 (1900)

28

As₂S₅**NaOH****I-1484**

A mixture of mono and dithiosodium arsenate and sodium thioarsenate is formed when arsenic pentasulfide is treated with sodium hydroxide.



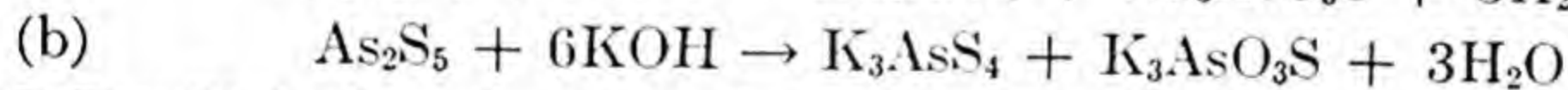
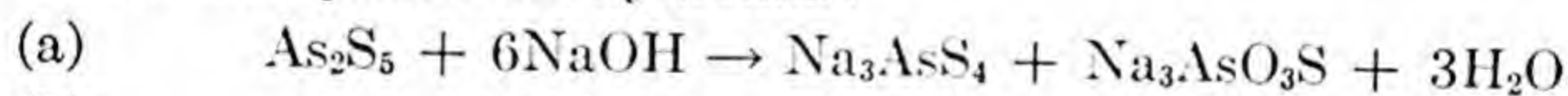
McCay: *Ber.*, **32**, 2471 (1899)

Ref., *Z. anorg. Chem.*, **26**, 322 (1901)

25

As₂S₅**NaOH****I-1485****KOH**

Arsenic pentasulfide is soluble in sodium hydroxide yielding sodium thioarsenate and sodium monothioarsenate. The same type reaction occurs with potassium hydroxide.

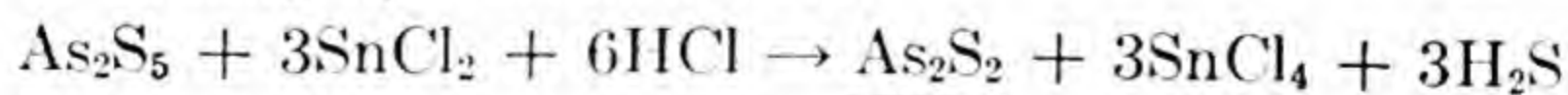


LeRoy W. McCay, *Z. anorg. Chem.*, **25**, 459 (1900)

28

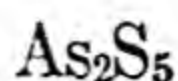
As₂S₅**SnCl₂****I-1486****HCl**

Arsenic disulfide is formed when a hydrochloric acid solution of stannous chloride reduces freshly precipitated arsenic pentasulfide in the presence of fuming hydrochloric acid.



Ehrenfeld, *Ber.* **40**, 3962 (1907)

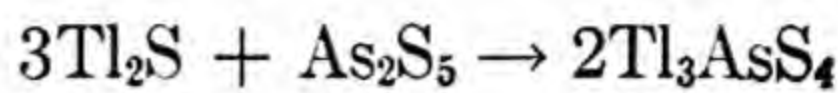
25



Tl₂S

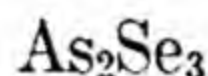
I-1487

Thallium thioarsenate precipitates as an orange powder when thallos sulfide and arsenic pentasulfide react with each other in alkaline solution.



L. F. Hawley, J. Am. Chem. Soc., **29**, 1013 (1907)

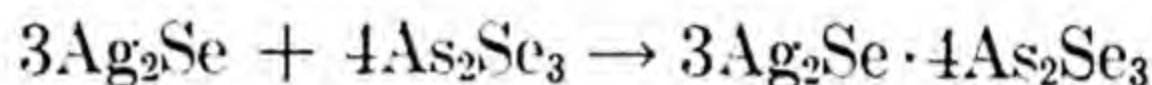
1



Ag₂Se

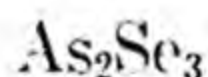
I-1488

The fusion curve for a mixture of silver selenide and arsenic triselenide passes through a maximum at the temperature corresponding to the compound shown below.



H. Pelabon, Compt. rend., **146**, 975 (1908)

38

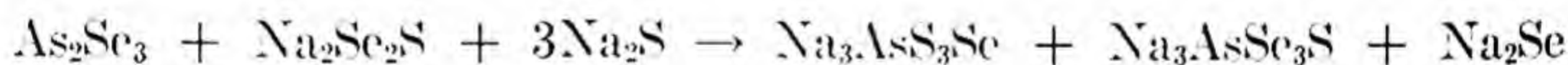


Na₂Se₂S

I-1489

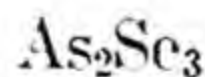
NaS

Sodium triselenothioarsenate along with some sodium monoselenotri-thioarsenate is obtained when arsenic triselenide is dissolved in sodium thioselenide and sodium sulfide solutions.



Messinger, Ber., **30**, 797 (1897)

25

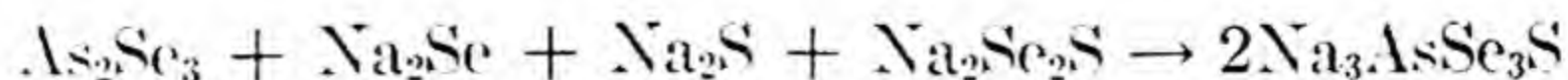


Na₂Se₂S

I-1490

Na₂Se

Sodium triselenothioarsenate is formed when an excess of sodium selenide is added to a solution containing sodium thioselenide and sodium sulfide and boiled.



Messinger, Ber., **30**, 797 (1897)

25

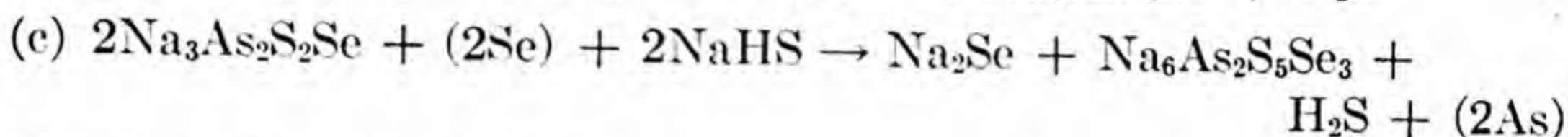
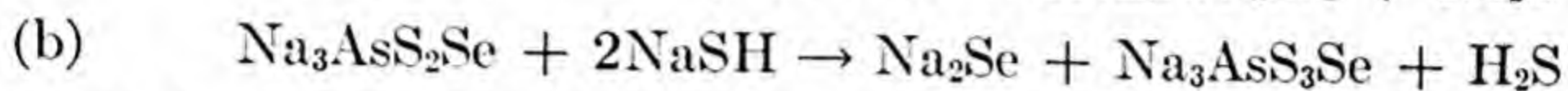
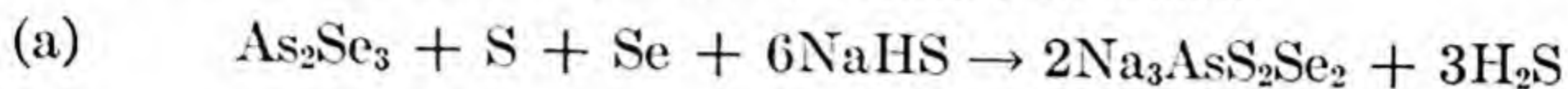
Se

 As_2Se_3

I-1491

NaHS

Reddish yellow prismatic crystals separate when pure arsenic triselenide, sulfur and selenium are dissolved in an excess of sodium hydrosulfide at room temperature. Sodium selenide and sodium monoseleno thioarsenate are obtained when the solution is boiled.



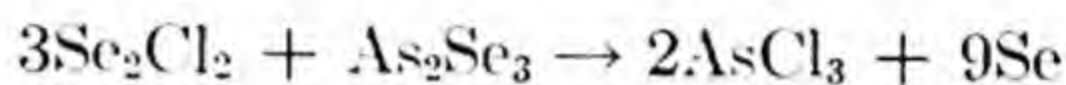
Messinger, Ber., **30**, 797 (1897)

25

 As_2Se_3 Se_2Cl_2

I-1492

Arsenic selenide and selenium monochloride yield arsenic trichloride and selenium when they react.



Lenher and Kao, J. Am. Chem. Soc., **48**, 1553 (1926)

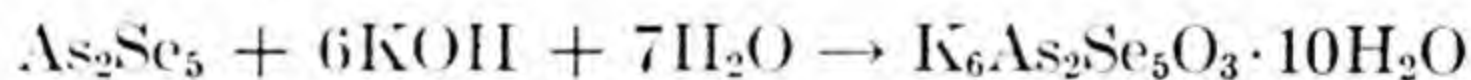
1

 As_2Se_5

KOH

I-1493

Dissolve 5 grams of arsenic pentaselenide in concentrated potassium hydroxide solution, filter into 300 cc absolute alcohol; crystals of orange red color are obtained.



A. Clever and W. Muthmann, Z. anorg. Chem., **10**, 117 (1895)

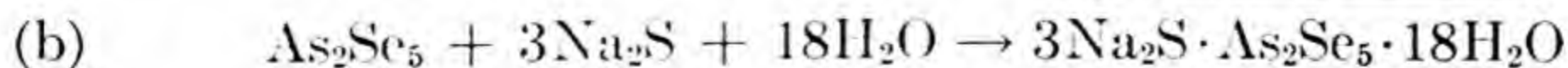
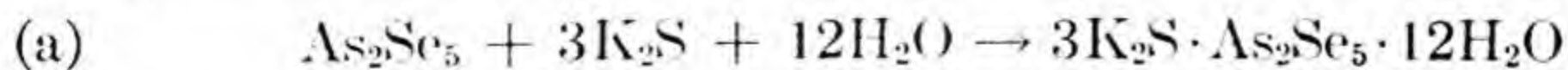
28

 As_2Se_5 K_2S

I-1494

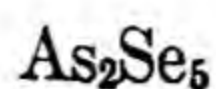
 Na_2S

By boiling arsenic pentaselenide with potassium sulfide a dark brown solution is formed. This solution filtered into absolute alcohol yields orange red crystals. The same type reaction occurs with sodium sulfide.



A. Clever and W. Muthmann, Z. anorg. Chem., **10**, 117 (1895)

28

**NaOH****I-1495**

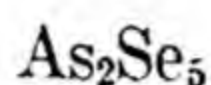
A mixture of sodium selenoarsenate and sodium monoselenoarsenate is formed when arsenic pentaselenide is dissolved in sodium hydroxide.



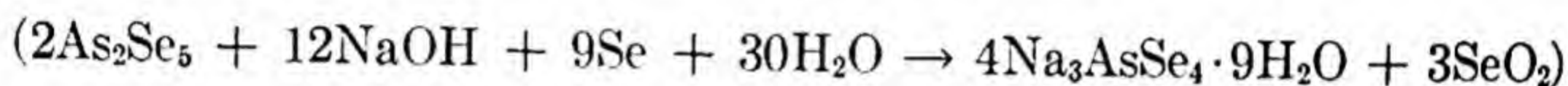
Szarvasy: Ber. **28**, 2654 (1895)

Ref., Weinland and Rumpf: Z. anorg. Chem., **14**, 42 (1897)

25

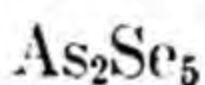
**NaOH****I-1496****Se**

Sodium selenoarsenate is formed when selenium dissolved in sodium hydroxide is treated with arsenic pentaselenide.

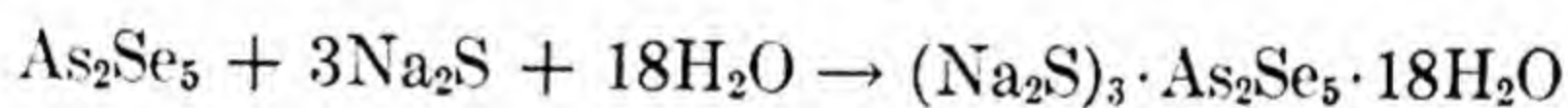


Clever and Muthmann: Z. anorg. Chem., **10**, 117 (1895)

25

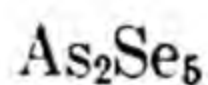
**Na₂S****I-1497**

Sodium thioselenoarsenate is obtained when a solution of sodium sulfide in caustic alkali is treated with arsenic pentaselenide and boiled.

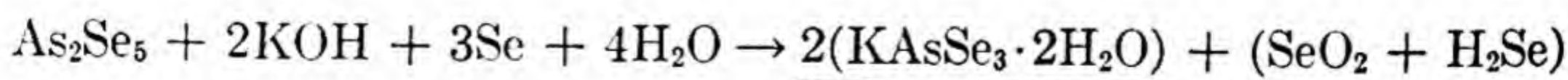


Clever and Muthmann: Z. anorg. Chem. **10**, 117 (1895)

25

**Se****I-1498****KOH**

By boiling arsenic pentaselenide with a solution of selenium in potassium hydroxide, then filtering into absolute alcohol, brown crystals are obtained.

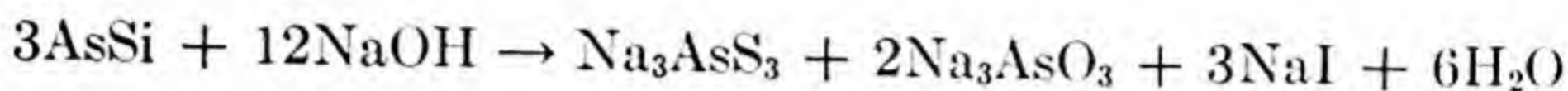


A. Clever and W. Muthmann, Z. anorg. Chem., **10**, 117 (1895)

28

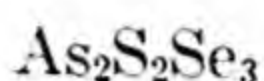
**NaOH****I-1499**

Arsenic thioiodide will be decomposed by the addition of sodium hydroxide to give sodium thioarsenite, sodium arsenite, sodium iodide and water.

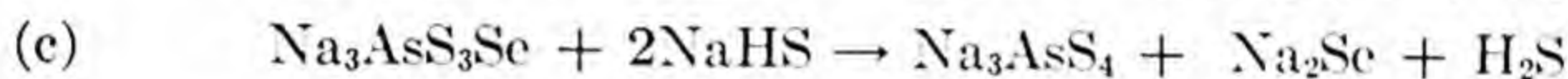
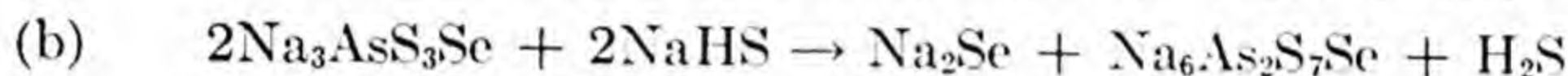
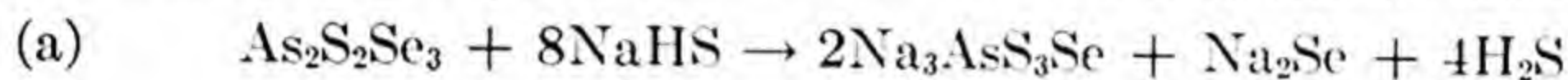


N. Tarugi: *Gazz. Chim. Ital.* **27**², 155 (1897)

21

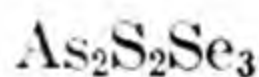
**NaHS****I-1500**

Brownish yellow, well formed prisms can be obtained by dissolving arsenic triselenium disulfide in sodium hydrosulfide and cooling the solution to -7° . The sodium thioarsenate and semiselenothioarsenate are formed if the experiment is carried on at a temperature above $60-70^\circ$.

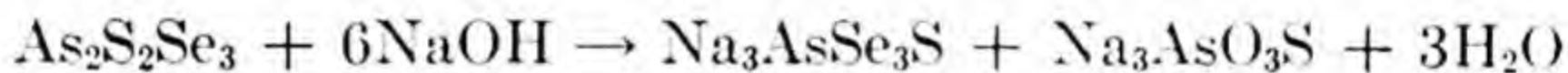


Messinger, *Ber.*, **30**, 797 (1897)

25

**NaOH****I-1501**

Crystals of sodium monothiotriselenoarsenate separate when arsenic triselenium disulfide dissolves in sodium hydroxide.



Szarvasy, *Ber.*, **28**, 2654 (1895)

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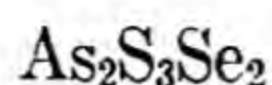
**NaOH****I-1502**

Sodium selenide is made when 25% sodium hydroxide which has been boiled in a stream of hydrogen to expel all absorbed air is treated with arsenic triselenium disulfide and heated to $40-50^\circ$.

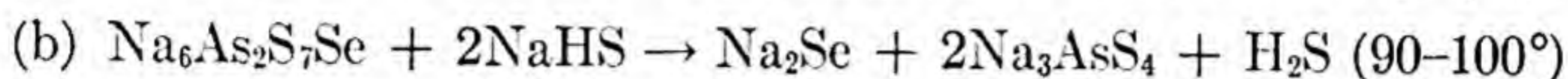
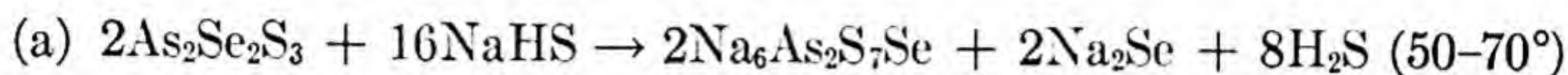


Messinger: *Ber.*, **30**, 797 (1897)

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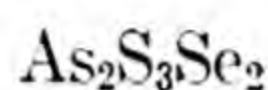
**NaHS****I-1503**

Yellow prismatic crystals separate and hydrogen sulfide evolves when arsenic diselenium trisulfide is dissolved in 25% freshly prepared sodium hydrosulfide solution first at room temperature, at 50–70° in a stream of hydrogen, and then cooled to –5°.

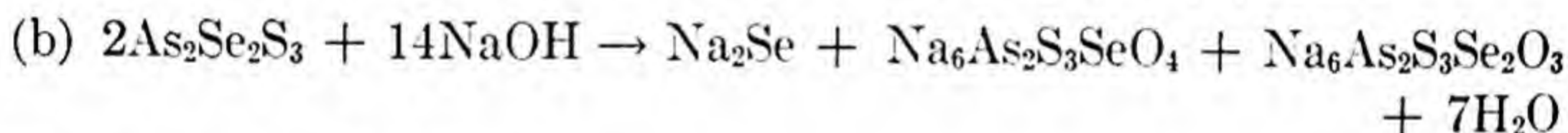
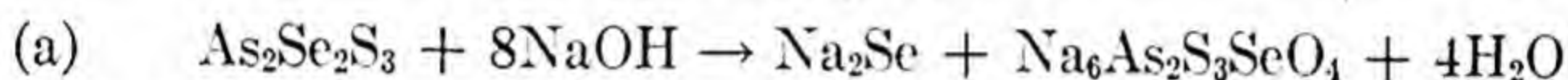


Messinger, Ber., **30**, 797 (1897)

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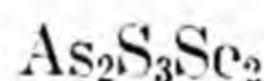
**NaOH****I-1504**

Radiating fuzzy colorless needles are obtained when arsenic diselenium trisulfide is dissolved in sodium hydroxide.

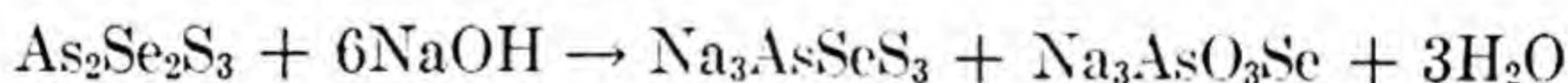


Messinger: Ber. **30**, 797 (1897)

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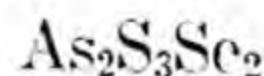
**NaOH****I-1505**

Sodium monoselenothioarsenate forms when arsenic diselenium trisulfide dissolves in sodium hydroxide.

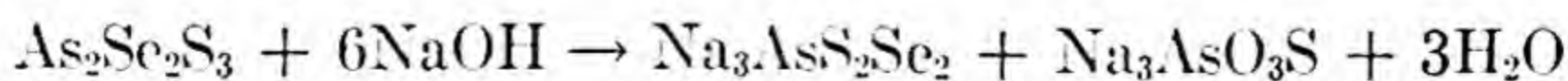


Szarvasy, Ber. **28**, 2654 (1895)

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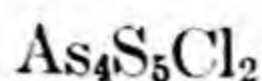
**NaOH****I-1506**

Crystals of sodium diselenodithioarsenate separate when arsenic diselenium trisulfide dissolves in sodium hydroxide. The same compounds are formed when arsenic triselenium disulfide is treated with sodium hydroxide.



Szarvasy, Ber., **28**, 2654 (1895)

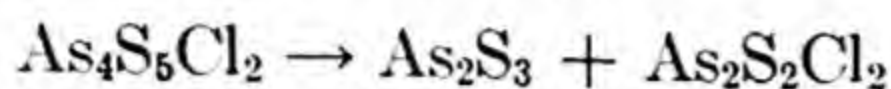
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Δ

I-1507

Microscopic crystals of diarsenic dichlorosulfide are obtained when tetraarsenic dichlorosulfide is heated to 180° for a long time in the presence of sulfuric acid and arsenic trichloride.



L. Ouvrard, *Compt. Rend.*, **116**, 1516

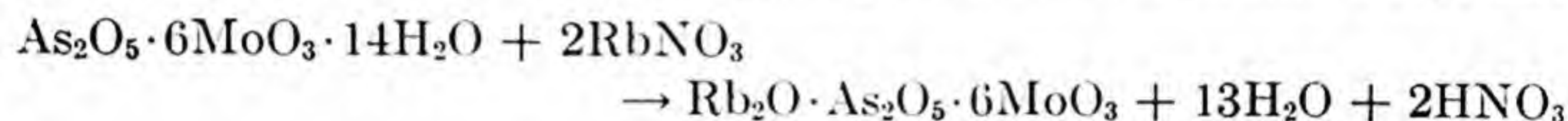
Ref., *Ber.*, **26**, 672 (1893)

25

RbNO₃

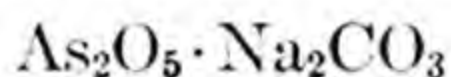
I-1508

A concentrated solution of arsenomolybdic acid (Pufahl's acid) will react with a concentrated solution of rubidium nitrate yielding a complex compound of rubidium arsenomolybdate in form of micro crystals.



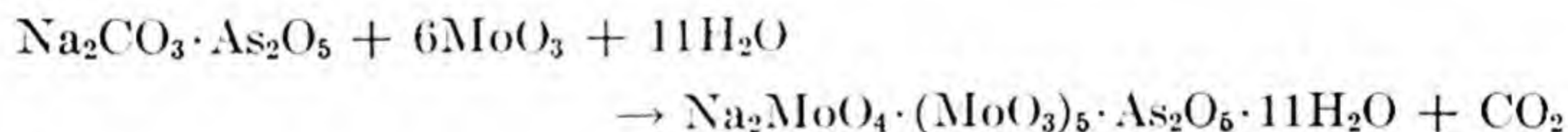
F. Ephraim and H. Herschfinkel, *Z. anorg. Chem.*, **65**, 237 (1910)

28

MoO₃

I-1509

When the calculated quantities of sodium carbonate-arsenic pentoxide and molybdic oxide are heated with water, and the reaction mixture allowed to stand several weeks, sodium arsenomolybdate crystallizes out.



P. Debray,

A. Henninger, *Ber.*, **7**, 820 (1874)

11

HNO₃

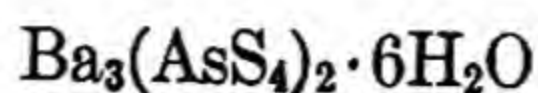
I-1510

Boil barium arsenate for a time with nitric acid (which may vary in concentration). On cooling the solution, crystals of barium nitrate deposit.

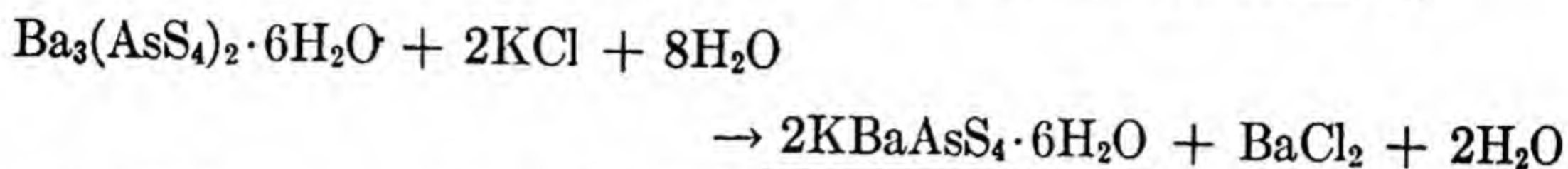


E. Duvillier, *Compt. Rend.*, **81**, 1251 (1875)

29

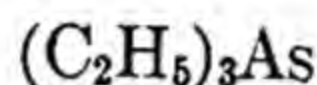
**KCl****I-1511**

A solution of barium orthothioarsenate will react with a solution of potassium chloride. By concentrating and cooling this solution colorless crystals of potassium-barium orthothioarsenate are obtained.

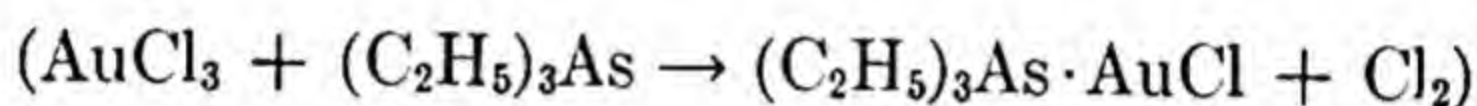


E. Glatzel, *Z. anorg. Chem.*, **71**, 209 (1911)

28

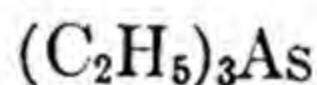
**AuCl₃****I-1512**

Triethyl arsine reacts with auric chloride, yielding the compound shown below.

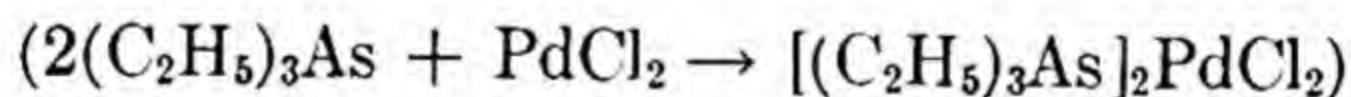


Frederick G. Mann and William J. Pope, *J. Chem. Soc. (London)*, **121**, 1755 (1922)

48

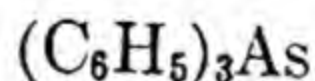
**PdCl₂****I-1513**

Triethyl arsine reacts with palladous chloride, yielding the compound shown below.

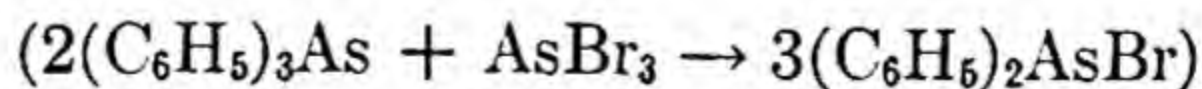


Frederick G. Mann and William J. Pope, *J. Chem. Soc.*, **121**, 1755 (1922)

48

**AsBr₃****I-1514**

If triphenyl arsine is heated with arsenic tribromide at 300–350° for three hours, and the resulting mixture is subjected to fractional distillation, the main product contained in the fraction 170–205° and in the residue is diphenyl arsenic bromide. Bromobenzene and benzene distil below 170°.



William J. Pope and Eustace E. Turner, *J. Chem. Soc.*, **117**, 1452 (1920)

48

AsCl₃**(C₆H₅)₃As****I-1515**

Phenyl arsine dichloride is formed when triphenyl arsine is heated with an excess of arsenic trichloride at 250°.

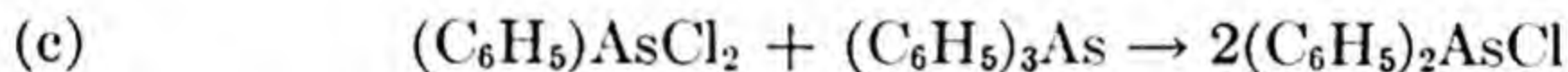
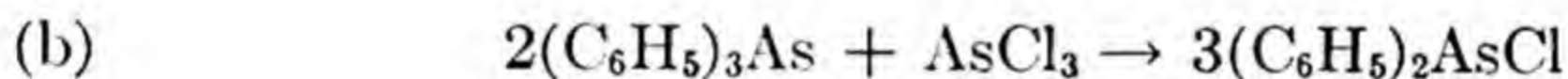
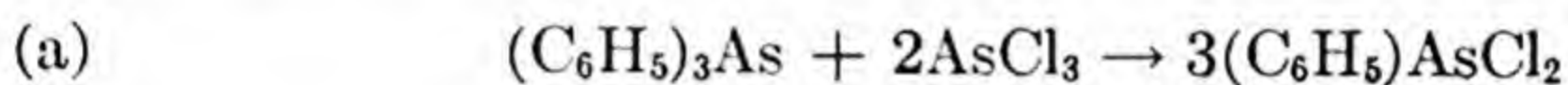


A. Michaelis and A. Reese, *Ber.*, **15**, 2876 (1882)

25

AsCl₃**(C₆H₅)₃As****I-1516**

If arsenic trichloride is slowly added to triphenylarsine at 350°, several reactions occur, whose products can be isolated by fractional distillation under 12–15 mm. pressure: (a) fraction 120–160° is nearly pure phenylarsine dichloride; (b) fraction 160–200° is pure diphenylarsine chloride; this compound may be formed also by the interaction of phenylarsine dichloride and triphenylarsine, (c).



Wm. J. Pope and Eustace E. Turner, *J. Chem. Soc. (London)*, **117**, 1451 (1920) 48

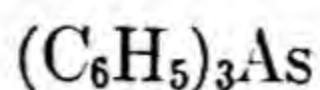
AsI₃**(C₆H₅)₃As****I-1517**

On heating triphenylarsine with arsenic triiodide for six hours in an open flask at 350–360° and distilling the resulting mass under diminished pressure, practically pure diphenyl arsine iodide distils at 204–205° at 10 mm; the yield is less than 50%, and the reaction does not proceed so satisfactorily as in the case of the corresponding bromo-derivative.



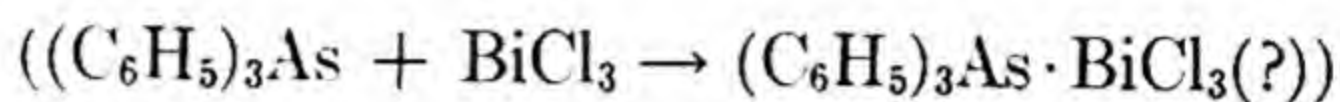
William J. Pope and Eustace E. Turner, *J. Chem. Soc. (London)*, **117**, 1452 (1920)

48

BiCl₃

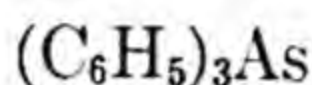
I-1518

Triphenylarsine (1 mole) is boiled in toluene with bismuth trichloride (1 mole) for six hours. Colorless crystals, probably of the double compound of the arsine and bismuth trichloride, deposit. The crystals become yellow in air. A slight odor of a phenylchloroarsine is detected, but the substance cannot be isolated.



Frederick Challenger and Leslie R. Ridgway, *J. Chem. Soc. (London)*, **121**, 116, 117 (1922)

48

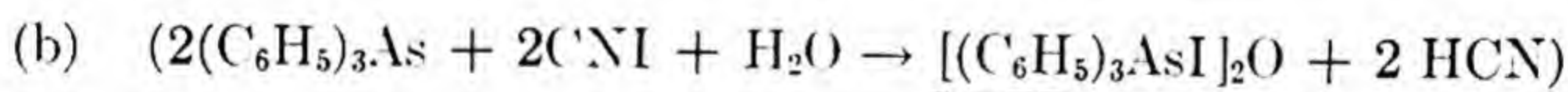
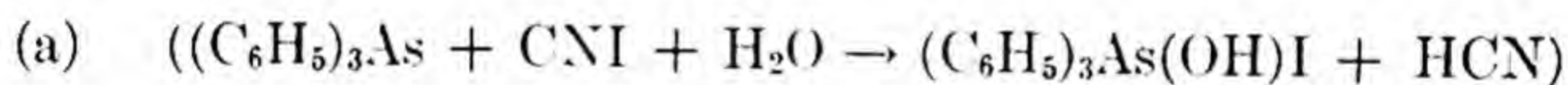


CNI

I-1519

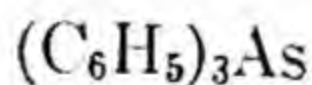
Triphenylarsine, when treated with cyanogen iodide in dry ether, deposits a yellow-reddish oil which solidifies gradually. This oil is probably either triphenylarsinehydroxy-iodide (a), or triphenylarsineoxyiodide (b).

Traces of nitrogen are found in the freshly formed oil, but they disappear after about 10 days standing.



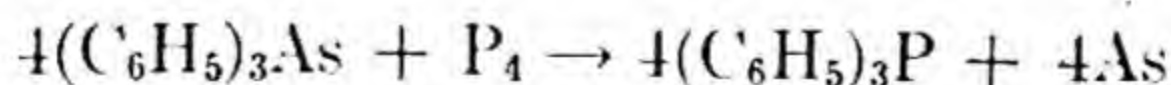
John F. Wilkinson and Frederick Challenger, *J. Chem. Soc. (London)*, **125**, 860 (1924)

48

P₄

I-1520

Triphenyl phosphine is obtained when a mixture of triphenyl arsine and phosphorus is heated for four hours in an ignition tube at 300°.

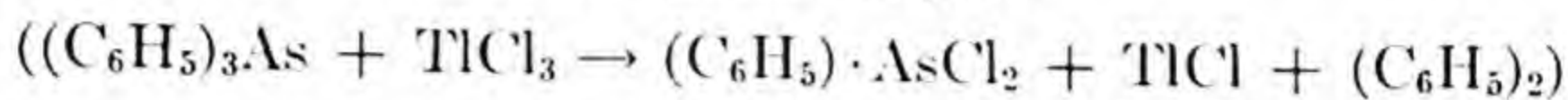


Krafft and Neumann, *Ber.*, **34**, 565 (1901)

25

TlCl₃**(C₆H₅)₃As****I-1521**

Triphenylarsine in dry ether is treated with an ethereal solution of thallic chloride and the mixture is left standing overnight. A white amorphous precipitate of thallic chloride is formed, and phenylarsine dichloride is isolated from the mother liquor.

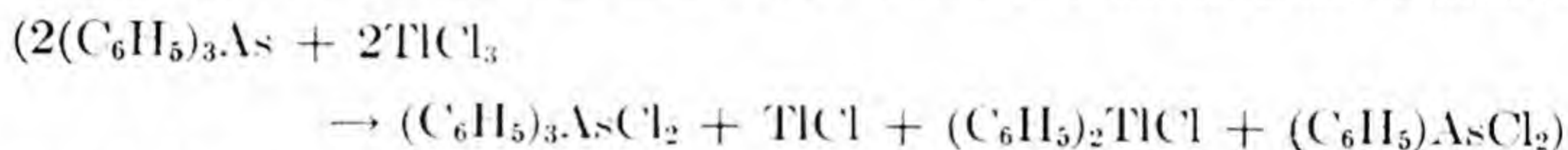


Archibald E. Goddard and Dorothy Goddard, *J. Chem. Soc. (London)*, **121**, 486 (1922)

48

TlCl₃**(C₆H₅)₃As****I-1522**

When triphenylarsine in dry ether is treated with a hot ethereal solution of thallic chloride, the resulting mixture consists of triphenyl arsenic dichloride, thallic chloride, diphenyl thallium chloride and phenyl dichloroarsine. If cold thallic chloride is used, the arsine is not oxidized.

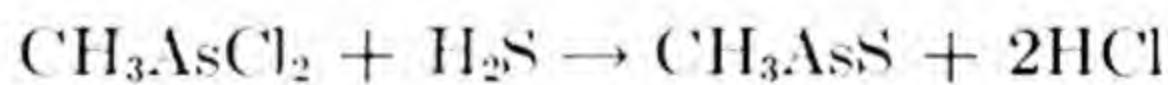


Archibald E. Goddard and Dorothy Goddard, *J. Chem. Soc.*, **121**, 486 (1922)

48

H₂S**CH₃AsCl₂****I-1523**

Methyl dichloroarsine will react with hydrogen sulfide yielding a precipitate of methylarsine sulfide.

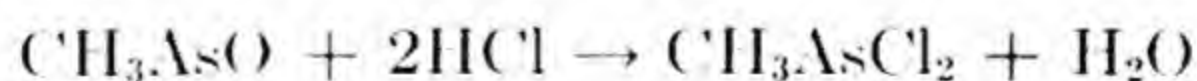


Nametkin and Nekrassow, *Z. anal. Chem.*, **77**, 285 (1929)

28

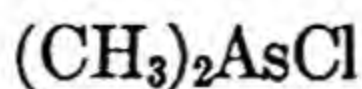
HCl**CH₃AsO****I-1524**

Methyl arsenine oxide is converted to methyl dichloroarsine by passing hydrogen chloride gas through its solution. The temperature should be about 85°C to prevent the formation of arsenic trichloride.

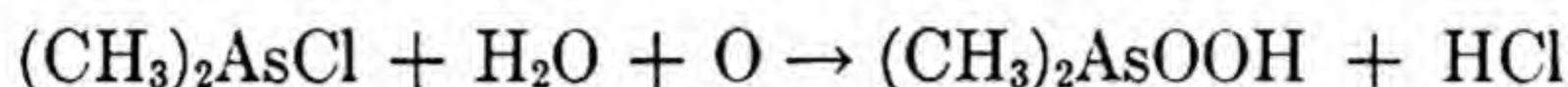


Uhlinger and Cook, *J. Ind. Eng. Chem.*, **11**, 105 (1919)

22

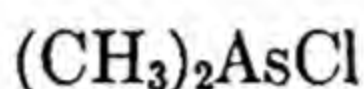
**H₂O****I-1525****O**

The conversion of volatile cacodyl chloride to non-volatile cacodylic acid takes place as shown in the following equation.

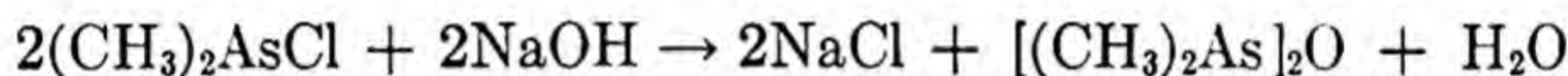


L. C. Maillard, Bull. Soc. Chim. [IV] **25**, 195 (1919)

31

**NaOH****I-1526**

Cacodyl chloride mixed with 10% sodium hydroxide and stirred at frequent intervals reacts slowly according to the following equation:

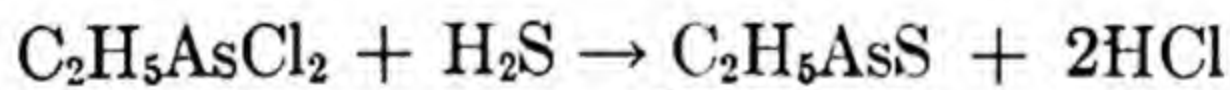


L. C. Maillard, Bull. Soc. Chim. [IV] **25**, 198 (1919)

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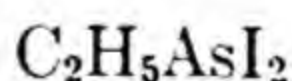
**H₂S****I-1527**

Ethyl dichloroarsine will react with hydrogen sulfide yielding a precipitate of ethyl arsine sulfide.

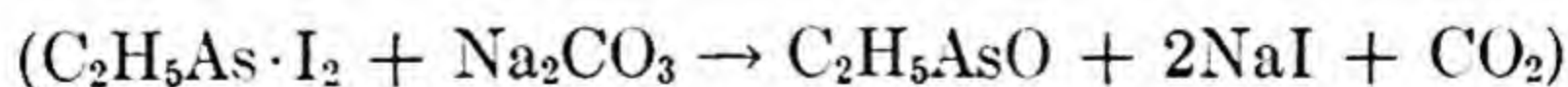


Nametkin and Nekrassow, Z. anal. Chem., **77**, 285 (1929)

28

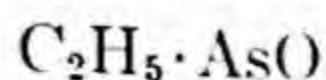
**Na₂CO₃****I-1528**

If ethyldiiodoarsine (dissolved in benzene) is mixed with calcium chloride and anhydrous sodium carbonate, and the mixture heated until the yellow color disappears, ethylarsine oxide will be formed after the benzene is distilled off.

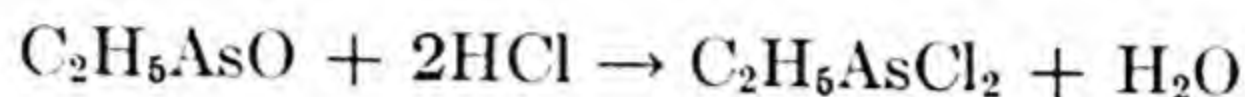


Alex. McKenzie and John K. Wood, J. Chem. Soc. (London), **117**, 408 (1920)

48

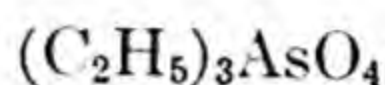
**HCl****I-1529**

Place 100 grams of ethylarsine oxide in a separatory funnel, add 25 cc. of concentrated hydrochloric acid and surround the funnel with cold water; then pass a current of hydrogen chloride through the oil for about three hours. Dry the oil, and the fraction distilling between 150°–155° will be ethyl dichloroarsine.

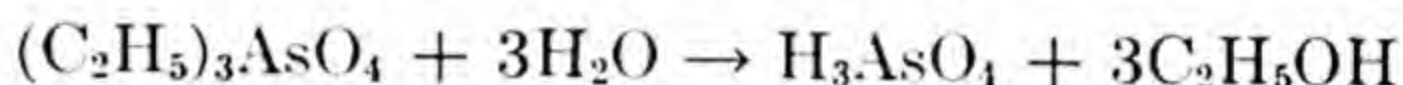


Alex. McKenzie and John K. Wood, *J. Chem. Soc. (London)*, **117**, 408 (1920)

48

**H₂O****I-1530**

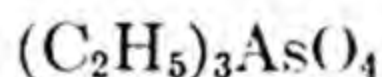
Water decomposes triethyl arsenate into arsenic acid and ethyl alcohol.



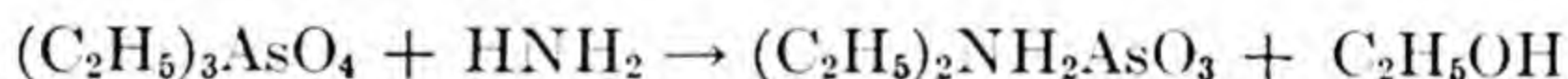
Crafts,

Ref.: *Ch. Friedel, Ber.*, **3**, 620 (1870)

11

**NH₃****I-1531**

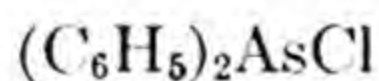
Dry ammonia reacts with triethyl arsenate to form diethyl amino arsenite and ethyl alcohol.



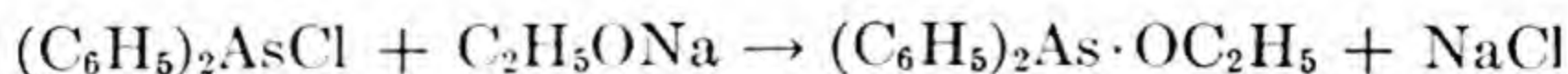
Crafts,

Ref.: *Ch. Friedel, Ber.*, **3**, 620 (1870)

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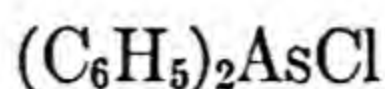
**C₂H₅ONa****I-1532**

If an alcoholic solution of diphenylchloroarsine is treated with alcoholic sodium ethoxide, the corresponding diphenylethoxyarsine is formed together with sodium chloride. After heating for one hour on the water bath, sodium chloride and the excess alcohol can be removed, leaving the reaction product in the form of a viscid oil which solidifies partly at room temperature.

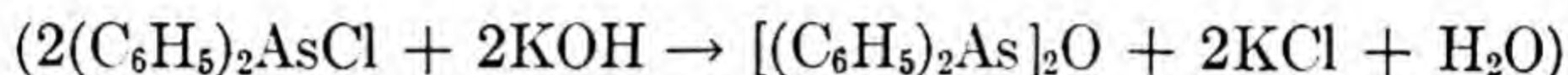


Alex. McKenzie and John K. Wood, *J. Chem. Soc. (London)*, **117**, 410 (1920)

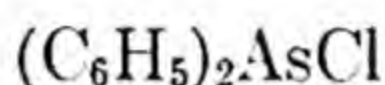
48

**KOH****I-1533**

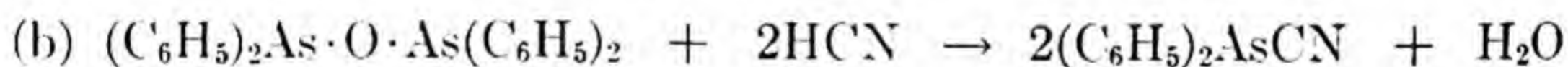
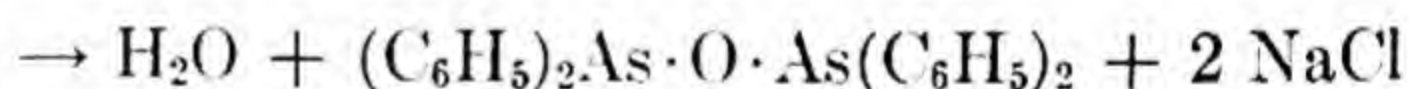
If an aqueous-alcoholic solution of potassium hydroxide is added to an alcoholic solution of diphenylarsine chloride and the mixture is boiled for an hour, a quantitative yield of pure diphenylarsenious oxide will be obtained. The oxide, after extraction with chloroform and drying, is a crystalline solid.



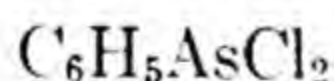
William J. Pope and Eustace E. Turner, *J. Chem. Soc. (London)*, **117**, 1451 (1920) 48

**NaOH****I-1534****HCN**

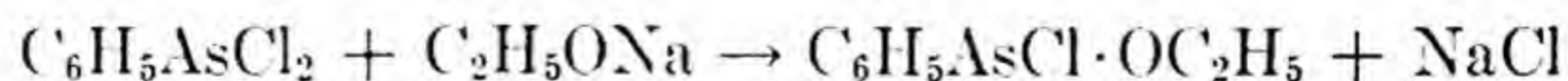
Diphenylchloroarsine may be converted into diphenyl arsenious oxide by the action of sodium hydroxide, (a). If a current of hydrogen cyanide is passed through molten diphenylarsenious oxide, diphenyl arsine cyanide is obtained, (b). This compound is so sensitive to alkali, that it can be reconverted into the oxide by the catalytic action of the alkali of the glass vessel.



Alex. McKenzie and John K. Wood, *J. Chem. Soc. (London)* **117**, 411 (1920) 48

**C₂H₅ONa****I-1535**

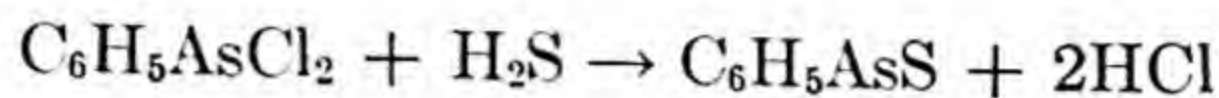
If 4.6 gr. of sodium are dissolved in 100 cc. of ethyl alcohol, and to the solution 44.6 gr. of phenyldichloroarsine are gradually added, phenyl ethoxychloroarsine will be formed. The yield, after removal of the alcohol and the sodium chloride, is 80%.



Alex. McKenzie and John K. Wood, *J. Chem. Soc.*, **117**, 410 (1920) 48

**H₂S****I-1536**

Phenyl dichloroarsine will react with hydrogen sulfide yielding a precipitate of phenyl arsine sulfide.

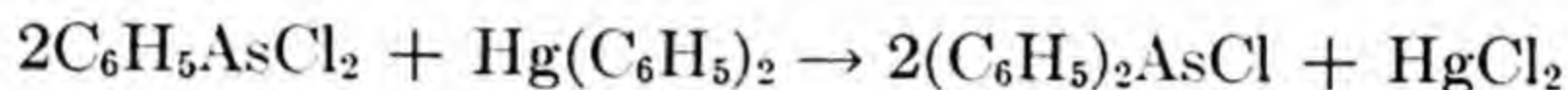


Nametkin and Nekrassow, *Z. anal. Chem.* **77**, 285 (1929)

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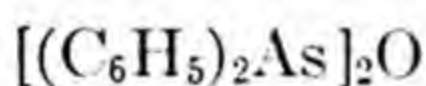
**Hg(C₆H₅)₂****I-1537**

Diphenyl arsine chloride is obtained when monophenyl arsenic chloride is treated with diphenyl mercury.

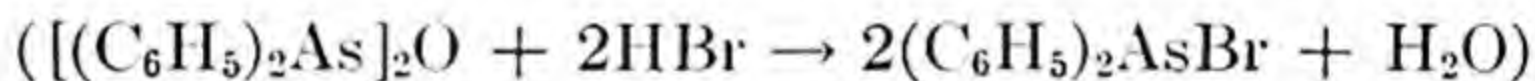


Michaelis and Link, *Ann.* **207**, 196 (1881)

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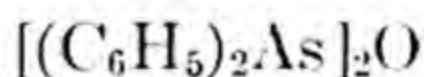
**HBr****I-1538**

On heating diphenyl arsine oxide at 100° with hydrobromic acid in a sealed tube and allowing to cool, diphenyl arsine bromide separates as a colorless, crystalline solid.

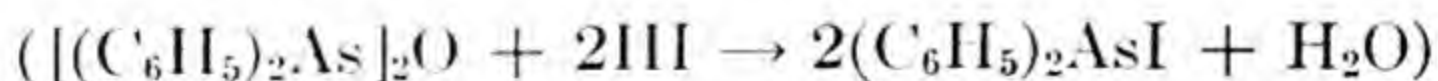


William J. Pope and Eustace E. Turner, *J. Chem. Soc. (London)*, **117**, 1452 (1920)

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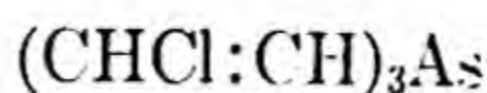
**HI****I-1539**

If diphenyl arsine oxide is heated with fuming hydriodic acid for two hours in a sealed tube at 100° and the mixture is allowed to cool, crude diphenyl arsine iodide solidifies; upon crystallization from benzene, this product is obtained in form of yellow crystalline scales melting at 45–46°.

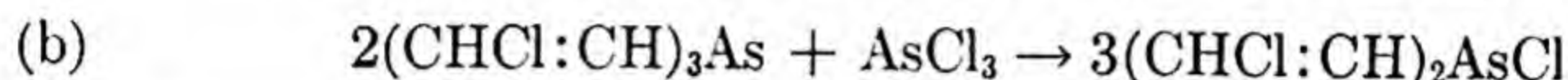
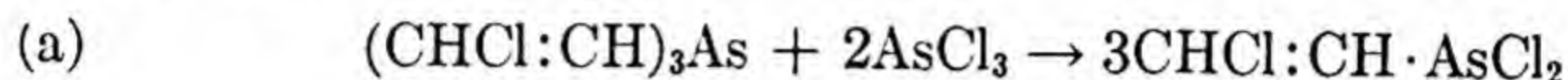


William J. Pope and Eustace E. Turner, *J. Chem. Soc.*, **117**, 1452 (1920)

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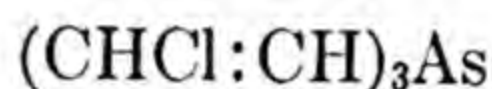
**AsCl₃****I-1540**

When pure trichlorovinylarsine is heated with arsenic trichloride at 200–220°, the resulting mixture will consist of unchanged arsenic trichloride and trichlorovinylarsine, (a) β -chlorovinylldichloroarsine, and (b) $\beta\beta'$ -dichlorodivinylchloroarsine. The proportions of the various compounds in the mixture depend on the proportions of the starting materials and the temperature.

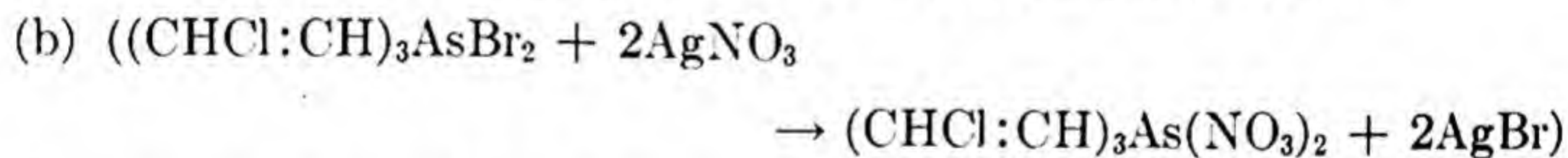
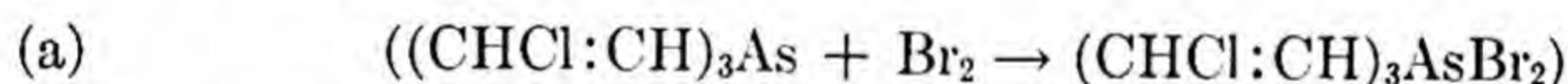


S. J. Green and T. L. Price, *J. Chem. Soc. (London)*, **119**, 453 (1921)

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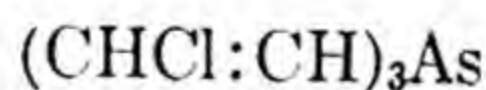
**Br₂****I-1541**

$\beta\beta'\beta''$ -trichlorotrivinylarsenic dibromide separates in colorless needles when $\beta\beta'\beta''$ -trichlorotrivinylarsine is cautiously treated in a freezing mixture with bromine, both in light petroleum solution, (a). Upon addition of silver nitrate to the solution, silver bromide precipitates quantitatively, (b).

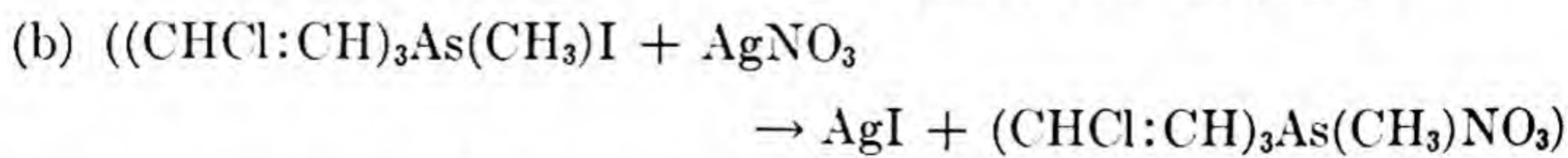
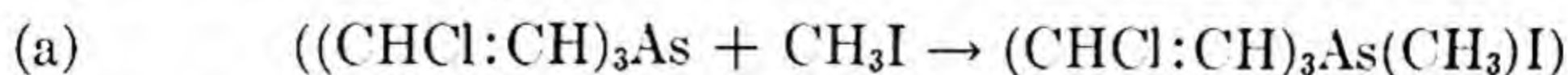


Frederick G. Mann and Wm. J. Pope, *J. Chem. Soc. (London)*, **121**, 1757 (1922)

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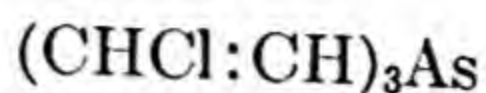
**CH₃I****I-1542**

On heating $\beta\beta'\beta''$ -trichlorotrivinylarsine with an equivalent portion of methyl iodide at 100° in a sealed tube, needle-shaped crystals of $\beta\beta'\beta''$ -trichlorotrivinylmethyларsonium iodide are obtained, (a). Upon acidifying a solution of this iodide and adding silver nitrate in the cold, a quantitative precipitate of silver iodide is obtained, (b).

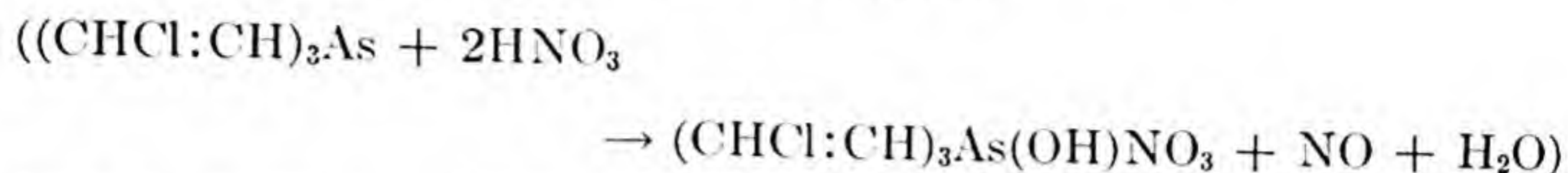


Frederick G. Mann and William J. Pope, *J. Chem. Soc. (London)*, **121**, 1758 (1922)

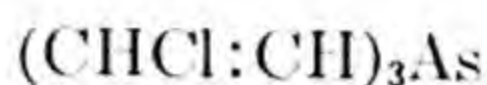
48

**HNO₃****I-1543**

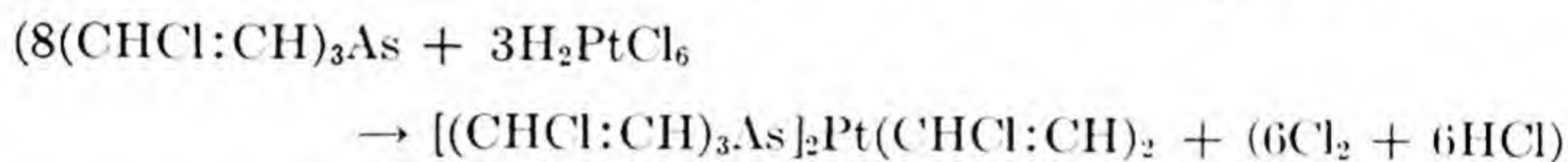
On warming $\beta\beta'\beta''$ -trichlorotrivinylarsine with an equal volume of concentrated nitric acid, a mass of colorless crystals of $\beta\beta'\beta''$ -trichlorotrivinylhydroxyarsonium nitrate is obtained.



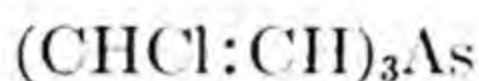
Frederick G. Mann and William J. Pope, J. Chem. Soc. (London), **121**, 1757 (1922) 48

**H₂PtCl₆****I-1544**

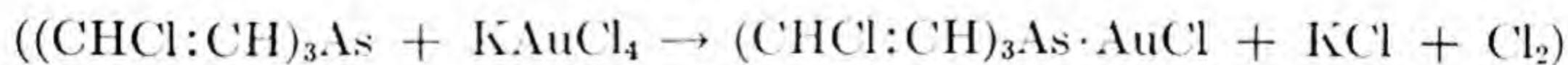
When a dilute alcoholic solution of chloroplatinic acid is added to an alcoholic solution of $\beta\beta'\beta''$ -trichlorotrivinylarsine, long pale yellow needles of platinum β -chlorovinyl $\beta\beta'\beta''$ -trichlorotrivinylarsine are obtained. If these crystals are recrystallized from dry ether in presence of excess arsine, a still more complicated platinum complex is obtained.



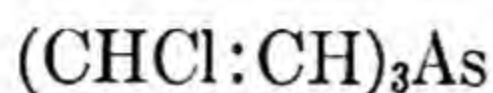
Frederick G. Mann and William J. Pope, J. Chem. Soc. (London), **121**, 1758 (1922) 48

**KAuCl₄****I-1545**

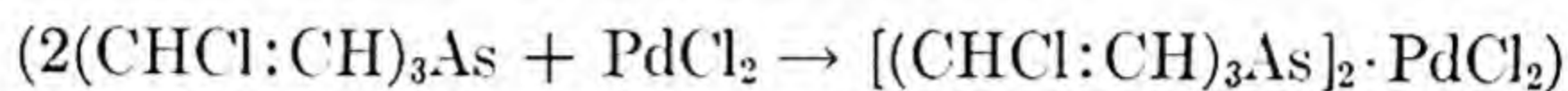
On adding an alcoholic solution of potassium aurichloride to a cooled alcoholic solution of trichlorotrivinylarsine, small heavy white crystals of $\beta\beta'\beta''$ -trichlorotrivinylarsine-aurichloride are slowly deposited. The crystals turn purplish-gray on exposure to light.



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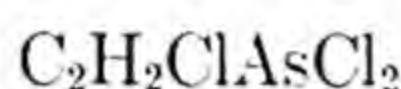
**PdCl₂****I-1546**

An alcoholic solution of palladous chloride is added to a cool alcoholic solution of $\beta\beta'\beta''$ -trichlorotrivinylarsine; long yellowish-brown needles of $\beta\beta'\beta''$ -trichlorotrivinylarsine-palladichloride begin to form within a few seconds. The formation of this compound furnishes a ready means for the detection of the tertiary arsine.

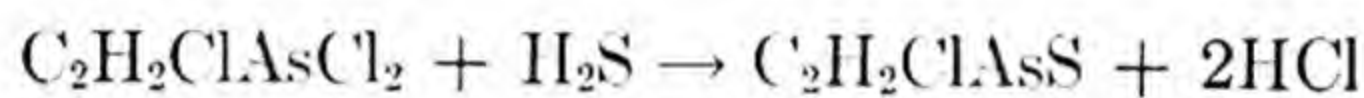


Frederick G. Mann and William J. Pope, *J. Chem. Soc.*, **121**, 1759 (1922)

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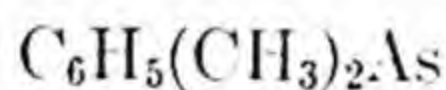
**H₂S****I-1547**

β -chlorovinyl dichloroarsine will react with hydrogen sulfide yielding a precipitate of β -chlorovinyl arsine sulfide.

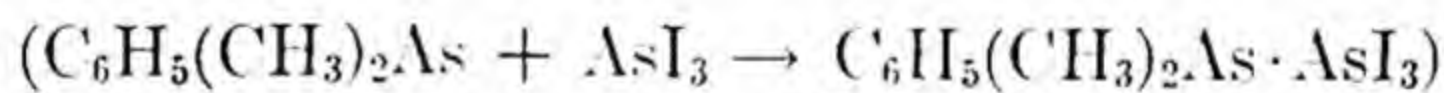


Nametkin and Nekrassow, *Z. anal. Chem.* **77**, 285 (1929)

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**AsI₃****I-1548**

On mixing boiling chloroform solutions of molecular proportions of phenyldimethylarsine and of arsenic triiodide, an addition compound separates out in form of orange leaflets melting at 153°.

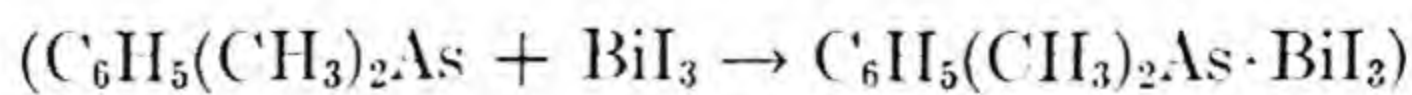


George J. Burrows and Eustace E. Turner, *J. Chem. Soc. (London)*, **119**, 1449 (1921)

48

**BiI₃****I-1549**

When an alcoholic solution containing bismuth iodide and phenyldimethylarsine in molecular proportions is boiled for a few minutes, vermilion crystals of the addition compound shown below are formed.

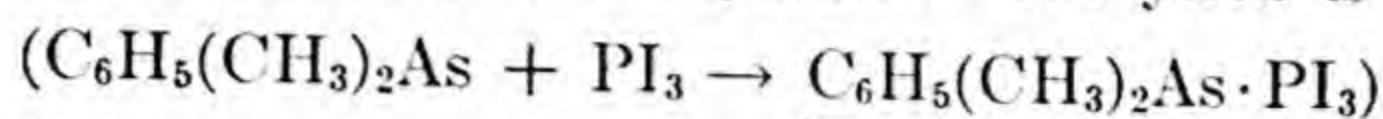


George J. Burrows and Eustace E. Turner, *J. Chem. Soc. (London)*, **119**, 1449 (1921)

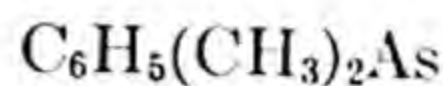
48

PI₃**I-1550**

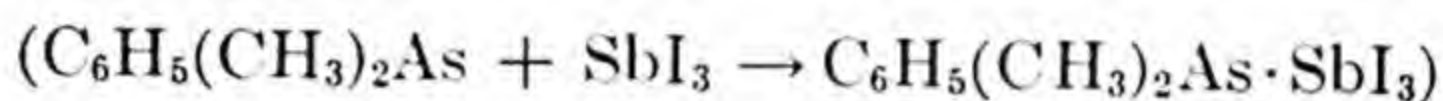
When phenyldimethylarsine (1 mole) is added to a solution of phosphorus triiodide (1 mole) in carbon disulfide, heat is evolved and orange prisms of an addition compound separate. The yield is quantitative.



George J. Burrows and E. E. Turner, J. Chem. Soc. (London), **119**, 1449 (1921) 48

SbI₃**I-1551**

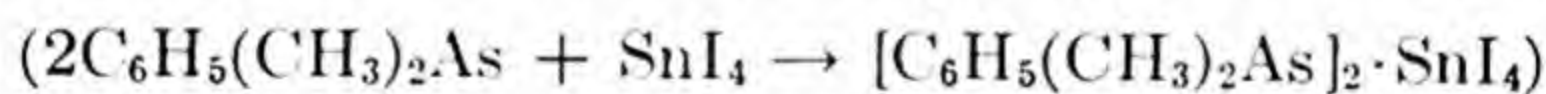
Antimony triiodide is dissolved in boiling benzene, and the solution treated with a molecular quantity of phenyldimethylarsine dissolved in the same solvent. Orange crystals of an addition compound of the form shown below are formed.



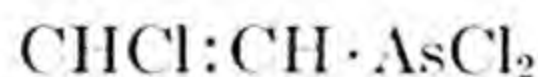
George J. Burrows and E. E. Turner, J. Chem. Soc. (London), **119**, 1449 (1921) 48

SnI₄**I-1552**

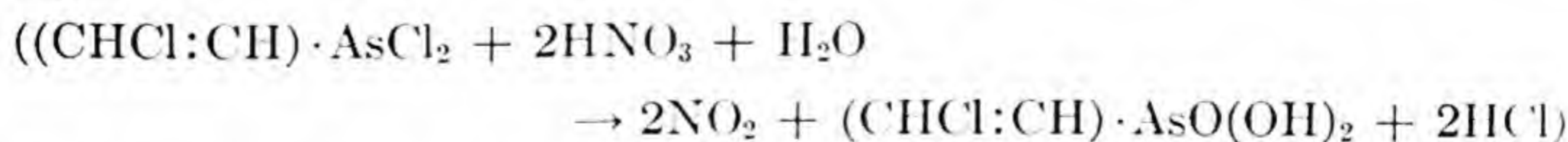
When the appropriate quantities of stannic iodide and phenyldimethylarsine are brought together in carbon disulfide solution, chocolate colored leaflets of the addition compound, shown below, separate.



G. J. Burrows and E. E. Turner, J. Chem. Soc. (London), **119**, 1449 (1921) 48

HNO₃**I-1553**

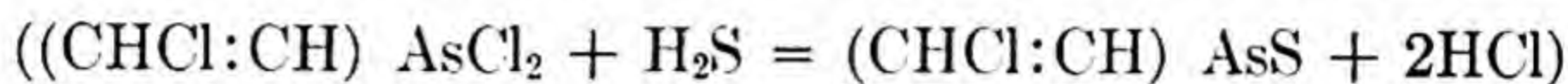
β -Chloro-vinyl-dichloroarsine is vigorously oxidized when warmed with an equal volume of concentrated nitric acid; the oxidation sets in spontaneously in the cold and the resulting solution, when chilled and scratched, deposits β -chloro-vinylarsenic acid as a mass of colorless crystals.



Frederick G. Mann and W. J. Pope, J. Chem. Soc. (London), **121**, 1755 (1922) 48

**H₂S****I-1554**

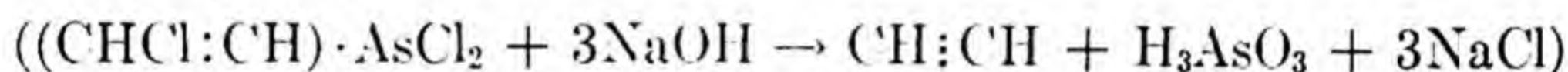
On treating β -chlorovinylarsine dichloride in carbon tetrachloride solution with hydrogen sulfide, hydrogen chloride is evolved and a viscous liquid deposits; the latter, after purification and strong cooling, solidifies to a hard resin which is β -chlorovinylarsine sulfide.



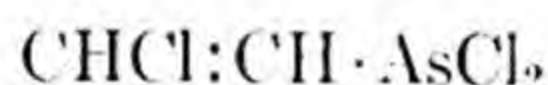
Frederick G. Mann and W. J. Pope, *J. Chem. Soc.*, (London), **121**, 1756 (1922) 48

**NaOH****I-1555**

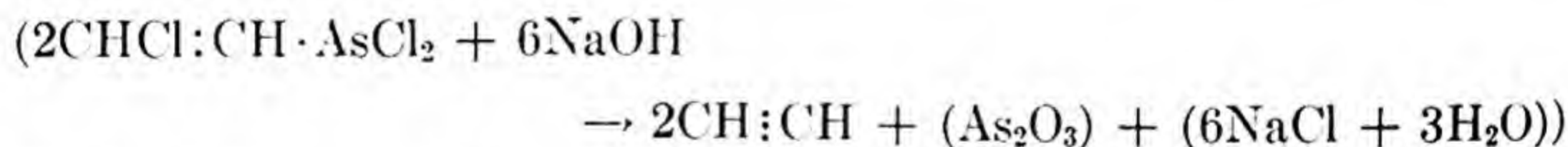
When β -chlorovinyl arsine dichloride is treated with a cold dilute solution of sodium hydroxide (or potassium carbonate), arsenious acid and acetylene are obtained.



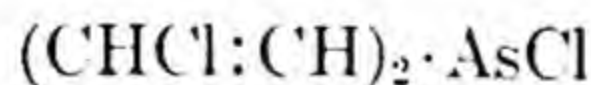
Frederick G. Mann and Wm. J. Pope, *J. Chem. Soc.* (London), **121**, 1756 (1922) 48

**NaOH****I-1556**

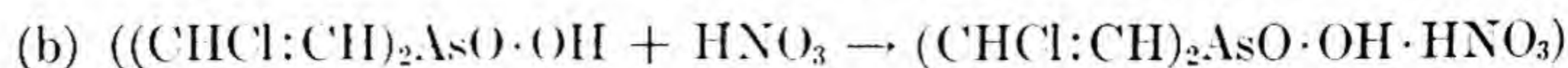
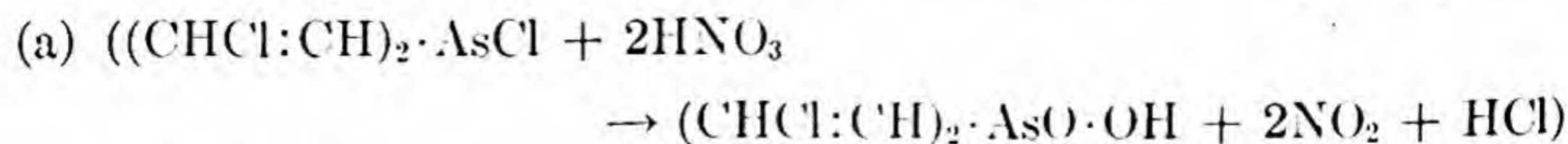
When a dilute solution of cold sodium hydroxide is added to a solution of β -chloro-vinyl-dichloro-arsine, a vigorous reaction sets in and acetylene is evolved with brisk effervescence. The same type reaction occurs with other alkali hydroxides.



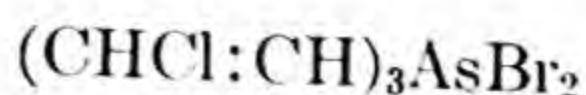
Stanley J. Green and Thomas S. Price, *J. Chem. Soc.* (London), **119**, 451 (1921) 48

**HNO₃****I-1557**

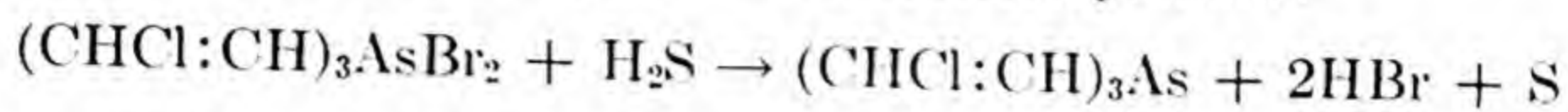
$\beta\beta'$ -Dichlorodivinyl-chloroarsine is oxidized by the action of nitric acid to $\beta\beta'$ -dichlorodivinylarsenic acid nitrate, (a) and (b). This product is first obtained in the form of a solid mass which, upon recrystallization from chloroform yields colorless needle-shaped crystals.



Frederick G. Mann and W. J. Pope, *J. Chem. Soc.* (London), **121**, 1756 (1922) 48

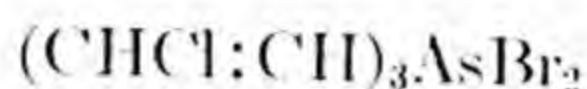
H₂S**I-1558**

Hydrogen sulfide acts on $\beta\beta'\beta''$ -trichlorotrivinylarsenic dibromide in chloroform solution with evolution of hydrogen bromide, deposition of sulfur and formation of $\beta\beta'\beta''$ -trichlorotrivinylarsine.

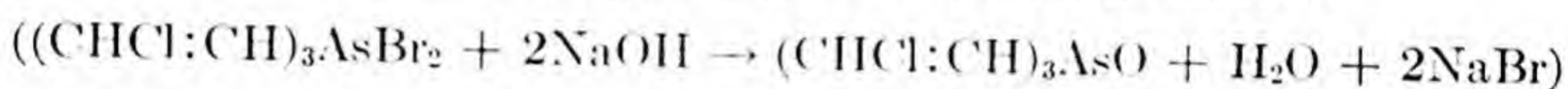


Frederick G. Mann and William J. Pope, J. Chem. Soc., **121**, 1757 (1922)

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NaOH**I-1559**

On hydrolyzing $\beta\beta'\beta''$ -trichlorotrivinylarsenic dibromide with the calculated quantity of sodium hydroxide and extracting the clear solution with chloroform, the corresponding $\beta\beta'\beta''$ -trichlorotrivinyl arsenic oxide is obtained after evaporating the chloroform solution.



Frederick G. Mann and William J. Pope, J. Chem. Soc., **121**, 1757 (1922)

48

HCN**I-1560**

If diphenyl-ethoxyarsine is heated in a current of dry hydrogen cyanide for three hours at 140°, diphenyl-cyanoarsine will be formed together with ethyl alcohol.

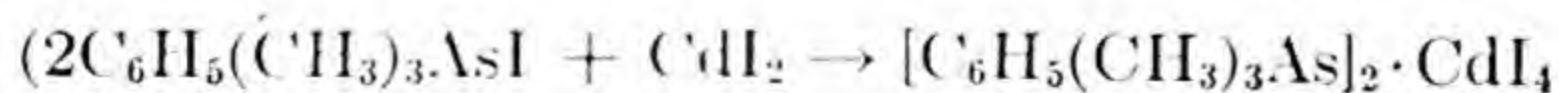


Alex. McKenzie and John K. Wood, J. Chem. Soc., **117**, 410 (1920)

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CdI₂**I-1561**

When cadmium iodide and phenyltrimethylarsonium iodide are mixed in aqueous solution, a quantitative white crystalline precipitate of phenyltrimethylarsonium cadmium iodide separates.



George J. Burrows and Eustace E. Turner, J. Chem. Soc. (London), **119**, 1449 (1921)

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**H₂O****I-1562**

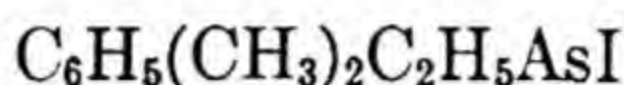
Water reacts with diethyl amino arsenite to form diethyl ammonium arsenate.



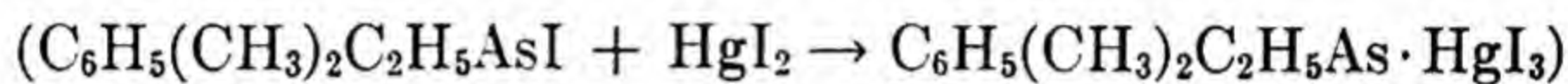
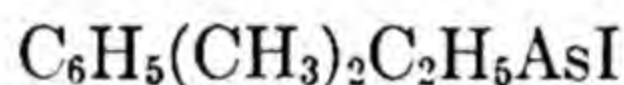
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Ref.: Ch. Friedel, Ber., **3**, 621 (1870)

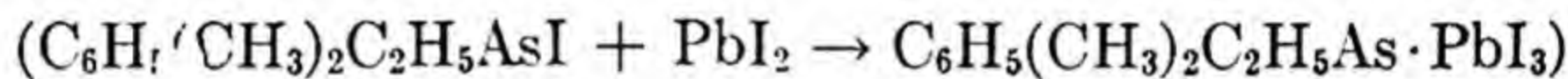
11

**HgI₂****I-1563**

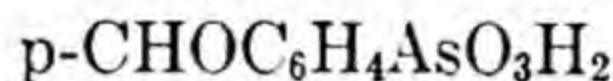
When mercuric iodide and phenyldimethylethylarsonium iodide are brought together in aqueous acetone, pale yellow prisms of phenyldimethylethylarsonium mercuric iodide are deposited.

George J. Burrows and E. E. Turner, J. Chem. Soc. (London), **119**, 1450 (1921) 48**PbI₂****I-1564**

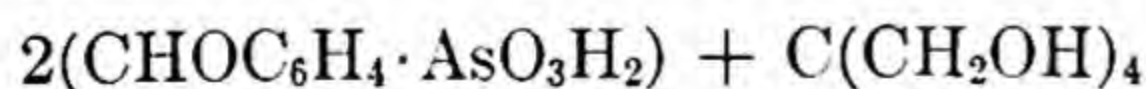
When phenyldimethyl-ethylarsonium iodide and lead iodide are brought together in aqueous acetone, pale yellow prisms of phenyldimethyl-ethylarsonium plumbic iodide separate.

George J. Burrows and Eustace E. Turner, J. Chem. Soc., (London) **119**, 1450 (1921)

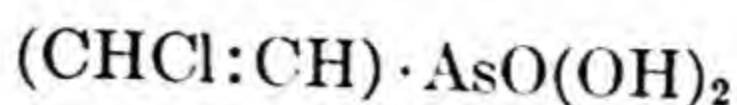
48

**C(CH₂OH)₄****I-1565**

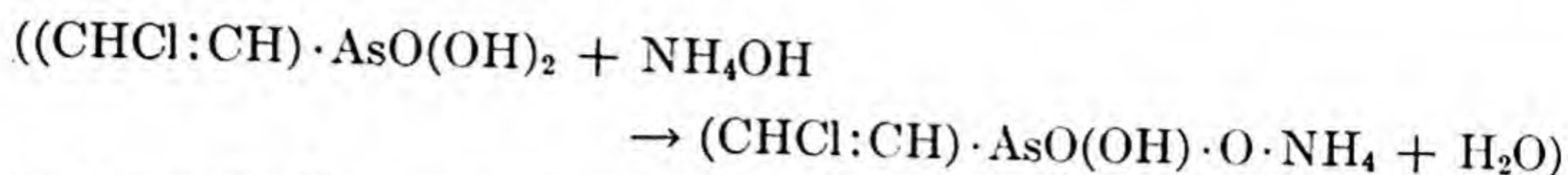
Benzaldehyde-p-arsenic acid (19.g) is dissolved at 100° in 53 ml. of 30% sulfuric acid containing 5.7 g. of pentaerythritol. The mixture is heated for 30 minutes, cooled, and the crystals which separate are dissolved in sodium hydroxide solution and decolorized with charcoal. From the filtered solution *dl*-spiro-bis-3,5-dioxane-4,4'-di(phenyl-p-arsonic acid) is precipitated with hydrochloric acid. The compound may be optically resolved with normal-*d*-pseudoephedrine.

C. S. Gibson and B. Levin, Proc. Roy. Soc., (London) **141A**, 494 (1933)

110

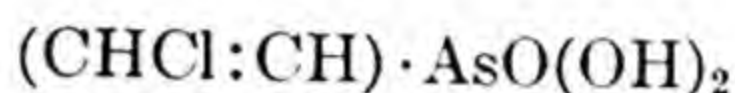
NH₄OH**I-1566**

On evaporating an ammoniacal aqueous solution of β -chloro-vinyl-arsenic acid, the corresponding ammonium salt is deposited in form of six sided plates or long needles.

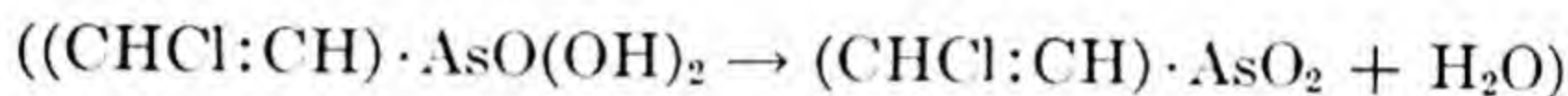


Frederick G. Mann and William J. Pope, J. Chem. Soc., (London) **121**, 1755 (1922)

48

 **Δ** **I-1567**

When β -chloro-vinylarsenic acid is heated in a vacuum at 110–115°, it loses one molecular proportion of water, giving the corresponding anhydride, namely β -chloro-vinylarsenic oxide, in form of a fine, white, hygroscopic powder.

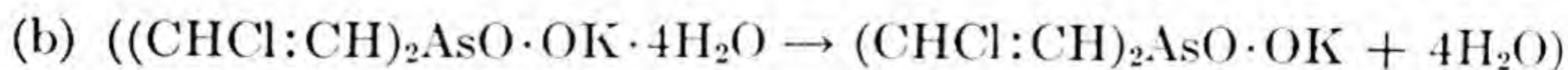
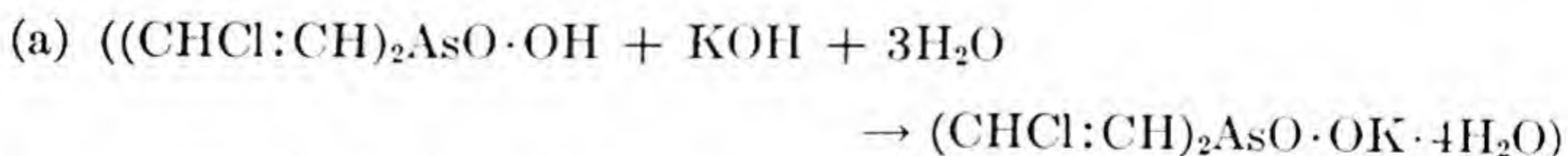


Frederick G. Mann and William J. Pope, J. Chem. Soc., (London) **121**, 1755 (1922)

48

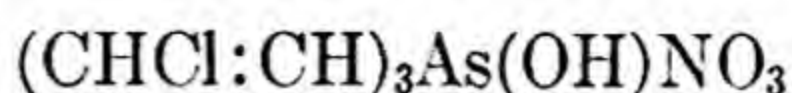
**KOH****I-1568**

On evaporating an aqueous solution of $\beta\beta'$ -dichloro-divinyl-arsenic acid with the equivalent quantity of potassium (or sodium) hydroxide, the corresponding potassium (or sodium) salt crystallizes out in tetra-hydrated colorless plates, (a). When kept in vacuo over phosphoric oxide for several days, the salt is dehydrated and the anhydrous white, hygroscopic salt is obtained.

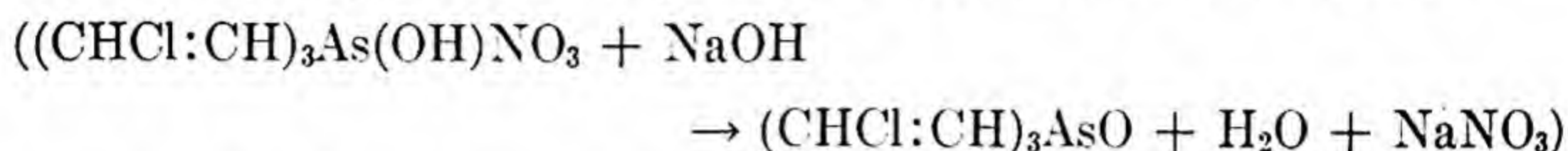


Frederick G. Mann and William J. Pope, J. Chem. Soc., (London) **121**, 1756 (1922)

48

**NaOH****I-1569**

When an aqueous solution of $\beta\beta'\beta''$ -trichloro-trivinyl-hydroxy-arsonium nitrate is treated with an equivalent amount of caustic soda, the solution extracted with chloroform and crystallized, $\beta\beta'\beta''$ -trichloro-trivinyl-arsenic oxide separates in long colorless needles or in small plates.

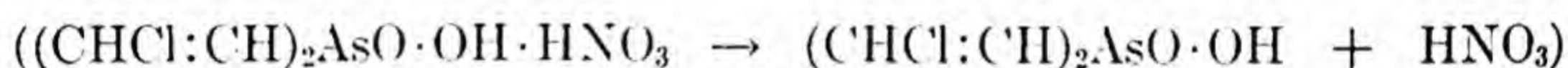


Frederick G. Mann and William J. Pope, J. Chem. Soc., (London) **121**, 1757 (1922)

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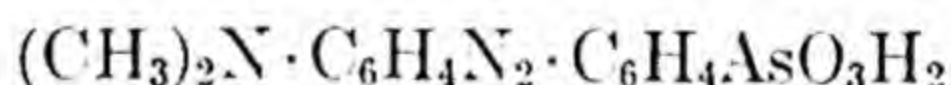
 Δ **I-1570**

On extracting an aqueous solution of $\beta\beta'$ -dichloro-divinyl-arsenic acid nitrate with chloroform and evaporating the extract, the nitric acid is driven off and the free $\beta\beta'$ -dichloro-divinyl-arsenic acid remains as a crystalline mass.

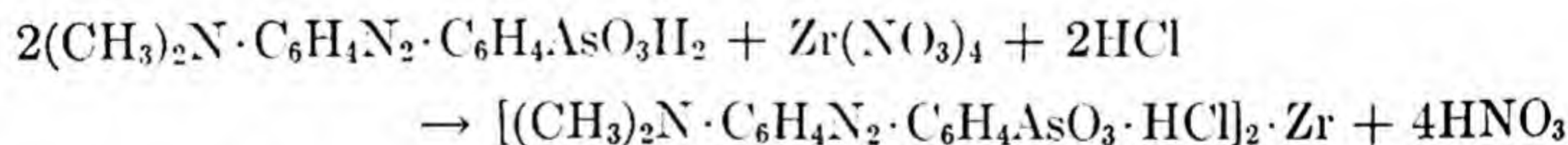


Frederick G. Mann and William J. Pope, J. Chem. Soc., (London) **121**, 1756 (1922)

48

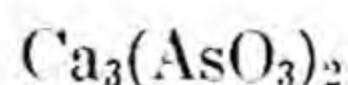
**Zr(NO₃)₄****I-1571**

Zirconium nitrate reacts with para-dimethyl aminoazophenylarsenic acid, yielding a brown precipitate.

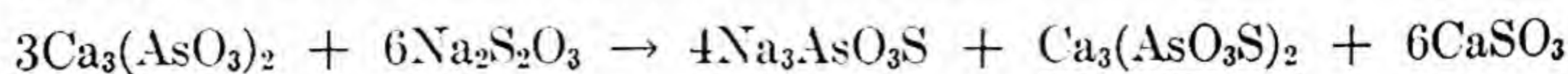


F. Feigl, P. Krumholz and E. Rajmaun, Mikrochem., **9**, 396 (1931)

28

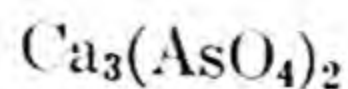
**Na₂S₂O₃****I-1572**

A precipitate of calcium monothioarsenate is formed when calcium arsenite is treated with sodium thiosulfate.

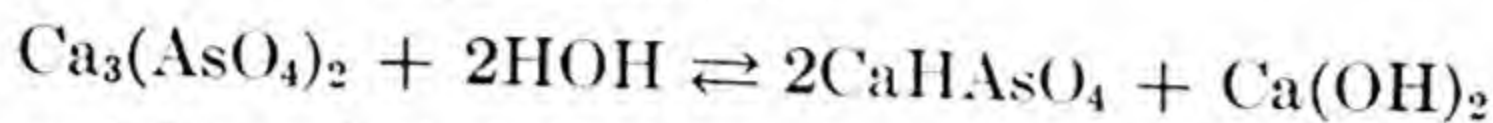


R. Weinland and A. Gutmann: Z. anorg. Chem. **17**, 409 (1898)

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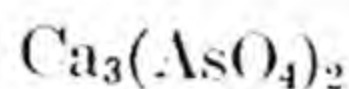
H₂O**I-1573**

Tricalcium arsenate hydrolyzes with water forming calcium hydroxide and calcium hydrogen arsenate.

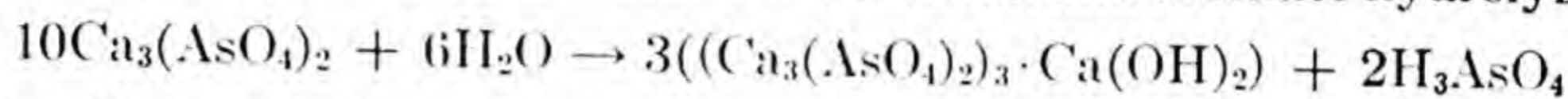


Reedy and Haag, *J. Ind. Eng. Chem.* **13**, 1039 (1921)

22

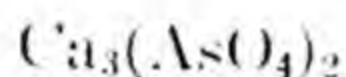
H₂O**I-1574**

A basic calcium arsenate is formed when tricalcium arsenate hydrolyzes.

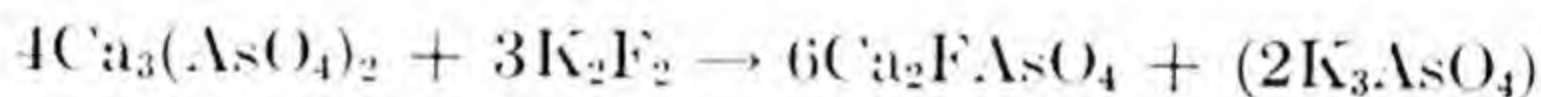


Tartar, Wood and Hiner, *J. Am. Chem. Soc.* **46**, 811 (1926)

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K₂F₂**I-1575**

Calcium fluoarsenate is formed when one part of calcium arsenate, three parts of potassium fluoride and a large excess of potassium chloride are heated in a platinum crucible.



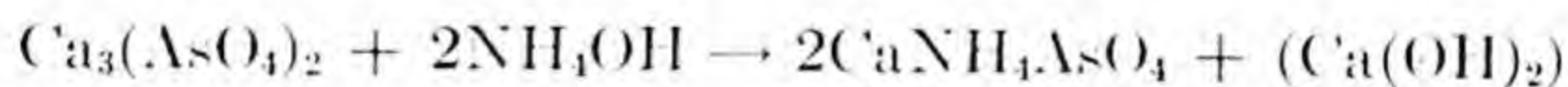
A. Ditte: *Compt. rend.* **99**, 967

Ref., *Ber.* **18**, 4 (1885)

25

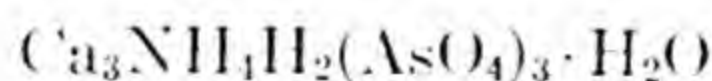
NH₄OH**I-1576**

Calcium ammonium arsenate precipitates when a solution of calcium arsenate is treated with ammonium hydroxide.

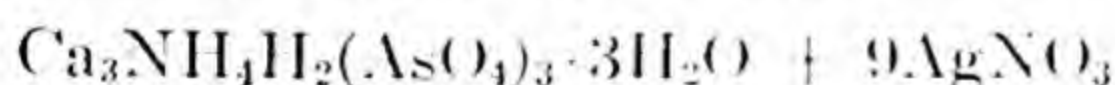


Tartar, Wood and Hiner, *J. Am. Chem. Soc.*, **46**, 810 (1924)

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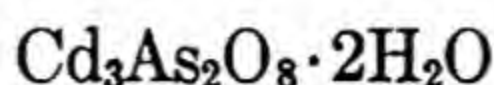
AgNO₃**I-1577**

Silver arsenate is formed when silver nitrate reacts with calcium ammonium dihydrogen arsenate.

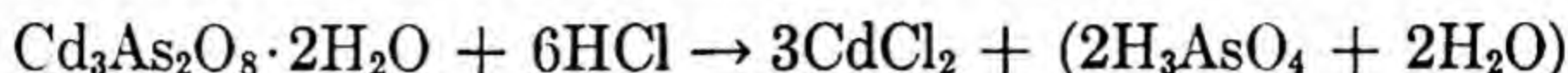


C. Bloxam, *Chem. News*, **54**, 168 (1886)

25

**HCl****I-1578**

Cadmium arsenate is completely converted into cadmium chloride when allowed to react with hydrogen chloride at 150°.

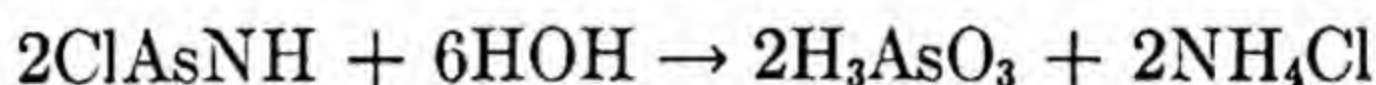


J. B. Moyer, J. Am. Chem. Soc., **18**, 1040 (1896)

1

**H₂O****I-1579**

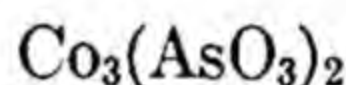
Arsenious acid and ammonium chloride are obtained when chloroarsenimide is treated with boiling water.



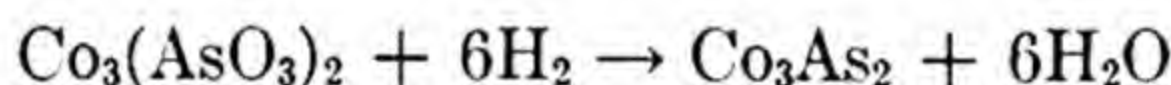
Pasteur, J. de Pharm. et de Chim, XIII, 395

Ref., Ann., **68**, 307 (1848)

25

**H₂****I-1580**

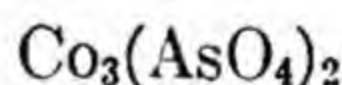
Cobalt arsenide is formed when cobalt arsenite is reduced by hydrogen at 900°C.



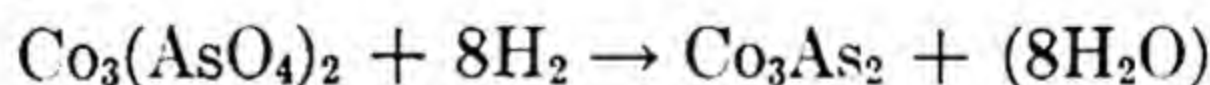
Ducelliez: Compt. Rend. **147**, 424 (1908)

Ref., E. Horton: J. Chem. Soc. **94**, 853 (1908)

25

**H₂****I-1581**

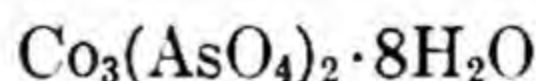
Tricobalt diarsenide is formed when cobalt arsenate is reduced with hydrogen at 900°C.



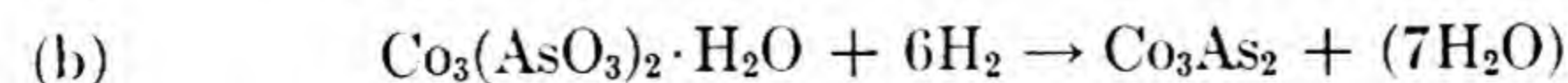
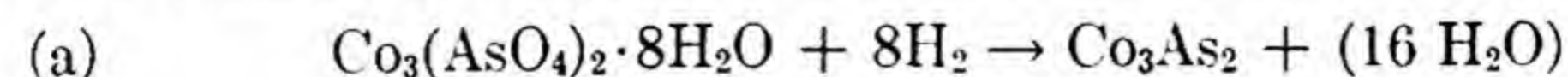
Ducelliez, Compt. rend., **147**, 424 (1908)

Ref., J. Chem. Soc. (London), **94**, 853 (1908)

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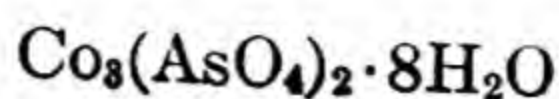
**H₂****I-1582**

When cobalt arsenate octahydrate (or cobalt arsenite monohydrate) is reduced by hydrogen at 900°, the lowest cobalt arsenide is formed.

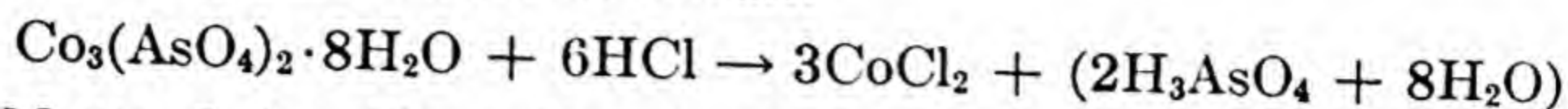


F. Ducelliez, Compt. rend., **147**, 425 (1908)

38

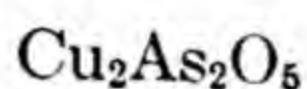
**HCl****I-1583**

Cobalt arsenate is readily attacked by hydrogen chloride in the cold yielding the pink chloride of cobalt.

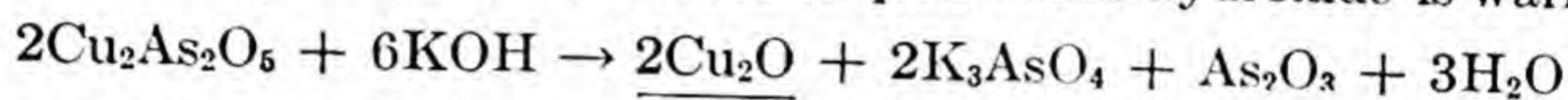


J. B. Moyer, J. Am. Chem. Soc., **18**, 1042 (1896)

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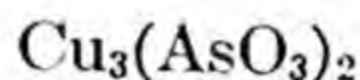
**KOH****I-1584**

Cuprous oxide precipitates when the dark blue solution obtained when copper pyroarsenite dissolves in potassium hydroxide is warmed

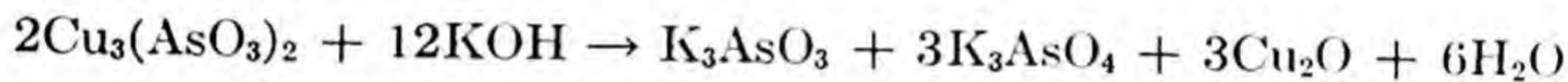


Reichard: Ber. **27**, 1019 (1894)

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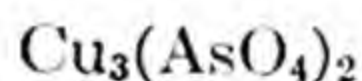
**KOH****I-1585**

Copper orthoarsenite is soluble in potassium hydroxide but after a time it decomposes.

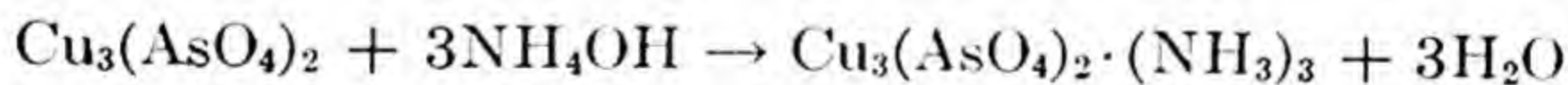


A. Reynoso, Compt. Rend. **31**, 69 (1850)

29

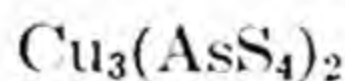
**NH₄OH****I-1586**

When a solution of cupric orthoarsenate in ammonium hydroxide to which a little alcohol has been added is allowed to evaporate in air, blue crystals of tetrahydrated cupric arsenate triammoniate are deposited.

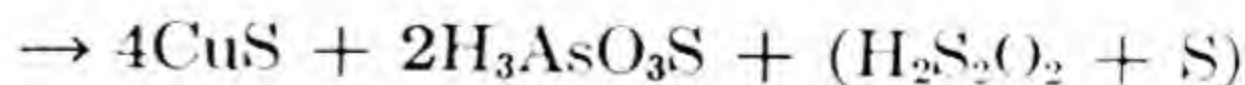
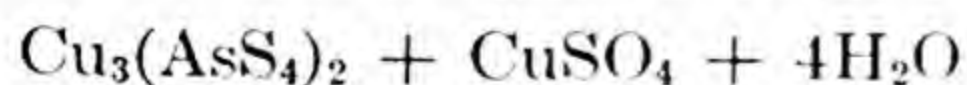


Girard, Compt. Rend., **36**, 794 (1853)

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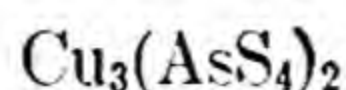
**CuSO₄****I-1587**

Black cupric sulfide is obtained along with monothioarsenic acid when cupric thioarsenate is heated with a solution of copper sulfate.



K. Preis, Ann., **257**, 201 (1890)

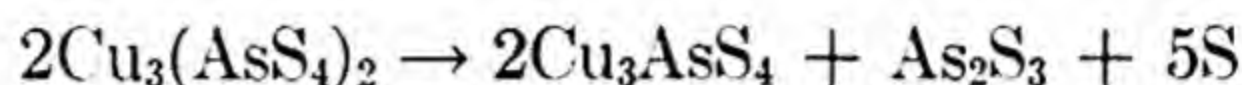
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Δ

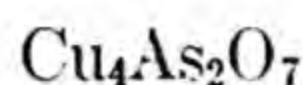
I-1588

A sublimate of sulfur and arsenic sulfide is formed along with a dark green crystalline mass of cuprous arsenate when cupric thioarsenate is heated in the absence of air.



Preis, Ann., **257**, 201 (1890)

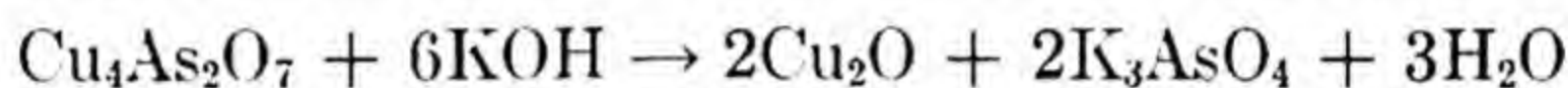
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KOH

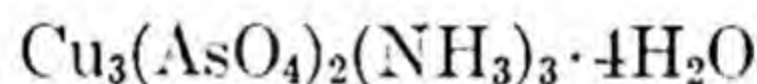
I-1589

Cuprous oxide separates quantitatively when cuprous pyroarsenate is dissolved in potassium hydroxide at ordinary temperature.



Reichard: Ber., **31**, 2163 (1898)

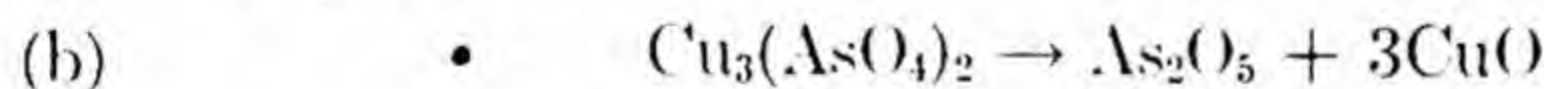
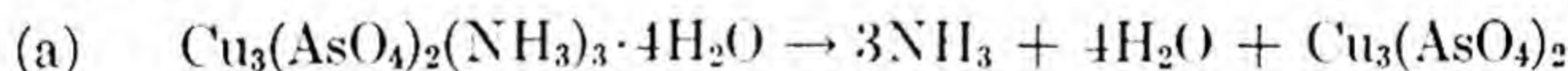
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Δ

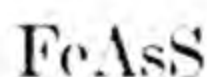
I-1590

Tetrahydrated cupric arsenate triammoniate loses water and ammonia when heated to 300°. At red heat in a glass tube its decomposition is complete and the components react with one another. The arsenic pentoxide is reduced to arsenic trioxide by the hydrogen of the ammonia.



A. Damour, Compt. Rend., **21**, 1423 (1845)

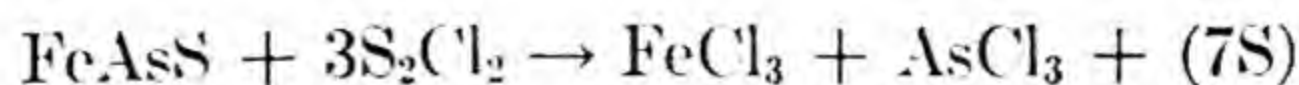
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S₂Cl₂

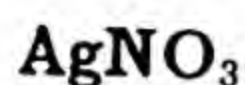
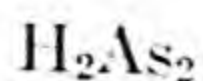
I-1591

Arsenopyrite is completely decomposed by sulfur monochloride when a mixture is heated in a sealed tube at 139° in an atmosphere of carbon dioxide.



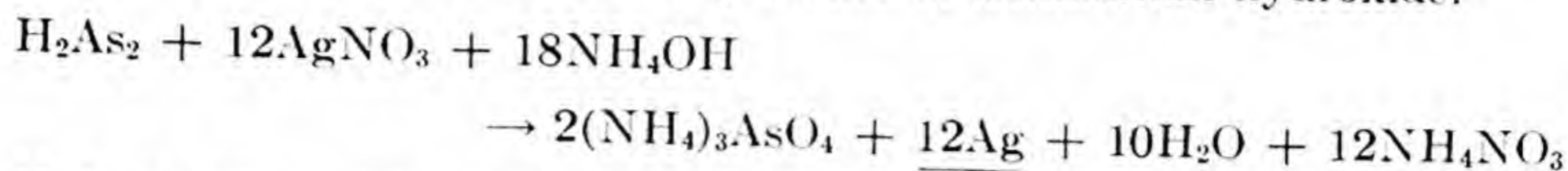
E. E. Smith, J. Am. Chem. Soc., **20**, 289 (1898)

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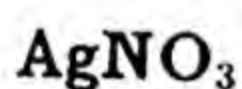
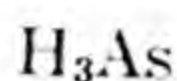
I-1592

Solid arsenic hydride is oxidized to ammonium arsenate by a diluted solution of silver nitrate in the presence of ammonium hydroxide.



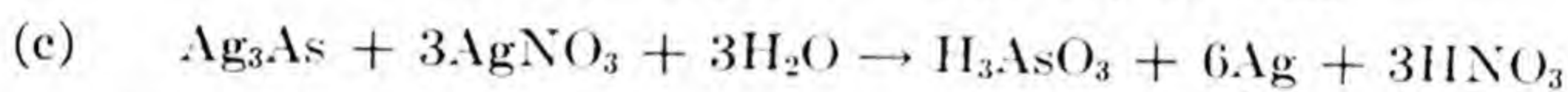
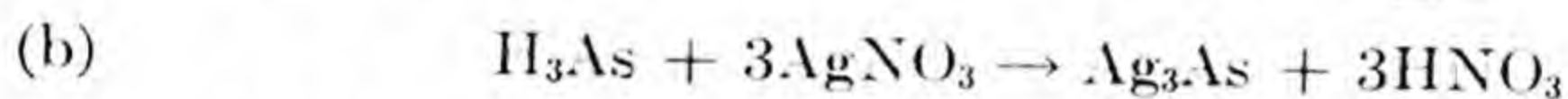
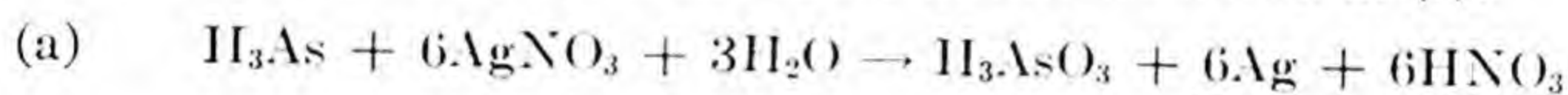
H. Reckleben and J. Scheiber, *Z. anorg. Chem.*, **70**, 255 (1911)

28



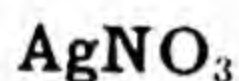
I-1593

When arsine and a neutral solution of silver nitrate are brought together the reaction proceeds as shown in (a) and (b) while the silver arsenide formed reacts slowly with the silver nitrate as shown in (c).

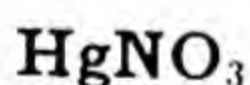


Reckleben, Lockemann and Eckardt, *Z. anal. Chem.*, **46**, 671 (1907)

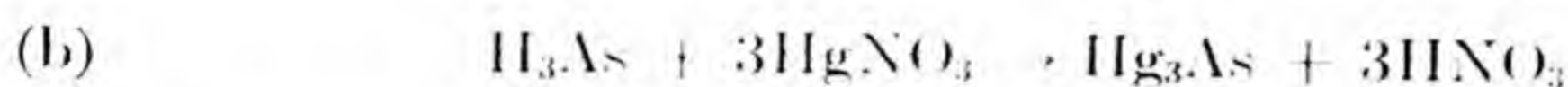
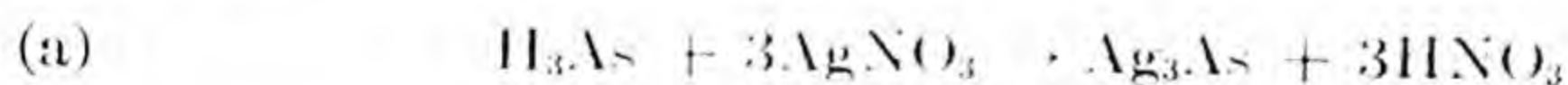
28



I-1594

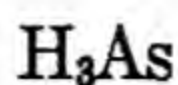


An amorphous precipitate of black colored silver arsenide is obtained by the reaction of arsine with diluted silver nitrate solution. The same type reaction occurs with a solution of mercurous nitrate yielding mercurous arsenide of black color.



A. Brukl, *Z. anorg. Chem.*, **131**, 236 (1923)

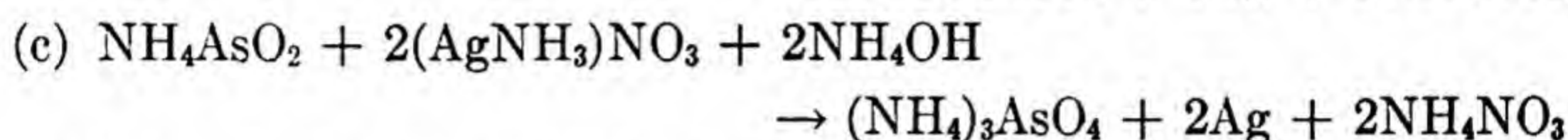
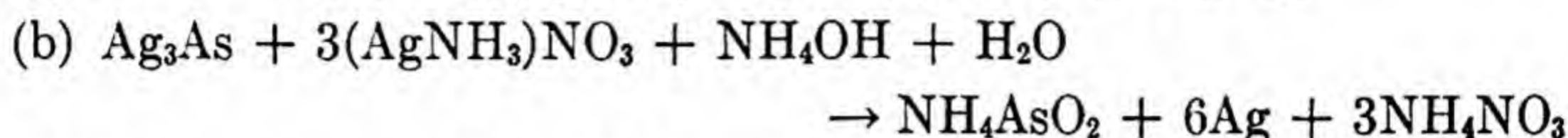
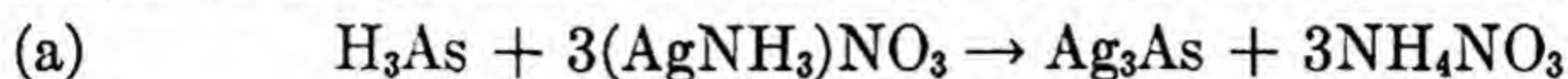
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I-1595

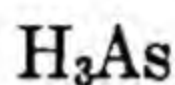


When arsine and a diluted solution of silver nitrate are brought together in the presence of ammonia, the reaction proceeds as follows:

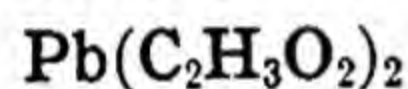
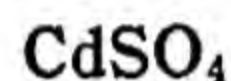


Reckleben, Lockemann and Eckardt, *Z. anal. Chem.*, **46**, 671 (1907)

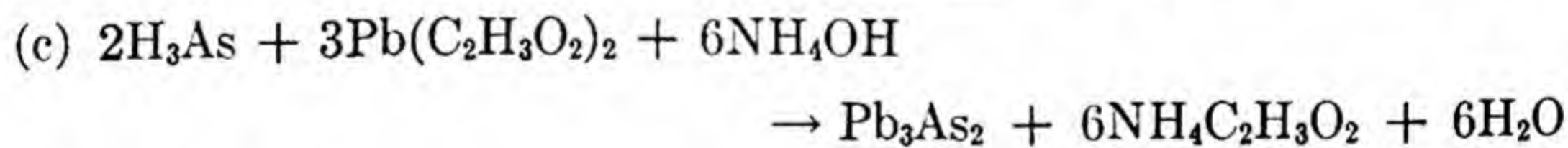
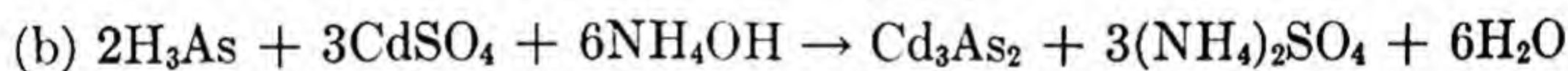
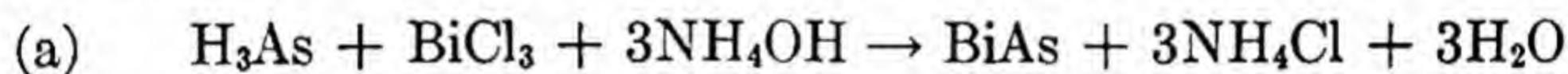
28



I-1596

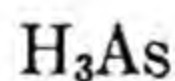


An amorphous precipitate of black color is obtained by the reaction of arsine with bismuth trichloride in the presence of ammonium hydroxide. The same type reaction occurs with cadmium sulfate and lead acetate, yielding cadmium arsenide and lead arsenide, also black products.



A. Brukl, *Z. anorg. Chem.*, **131**, 236 (1923)

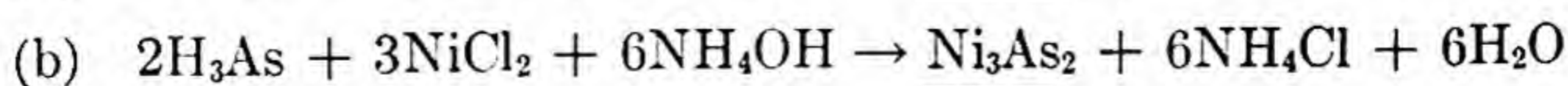
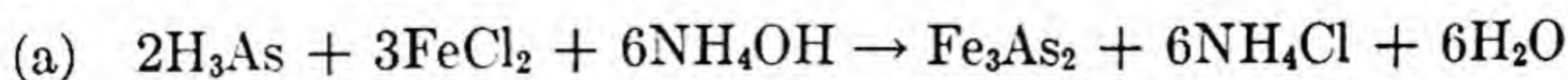
28



I-1597

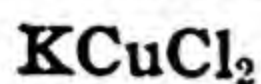
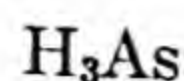


Arsine will react with ferrous chloride in alcoholic solution in presence of ammonia. Iron arsenide is obtained. The same type reaction occurs with nickelous chloride.



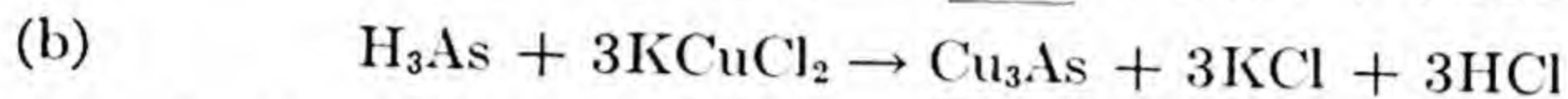
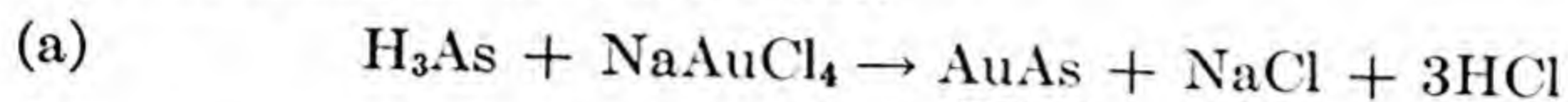
A. Brukl, *Z. anorg. Chem.*, **131**, 236 (1923)

28



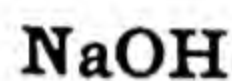
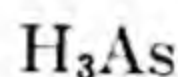
I-1598

An amorphous precipitate of black color, gold arsenide, is obtained by the reaction of arsine with sodium aurichloride. The same type reaction occurs with a solution of potassium cuprous chloride, yielding cuprous arsenide of black color.



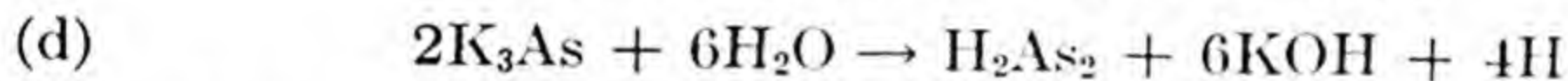
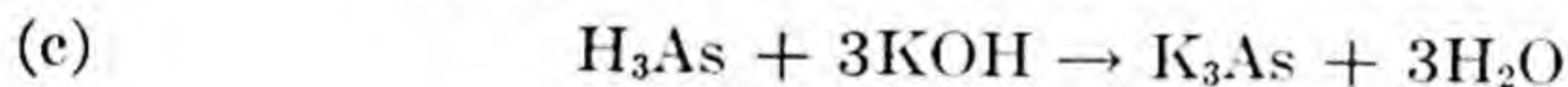
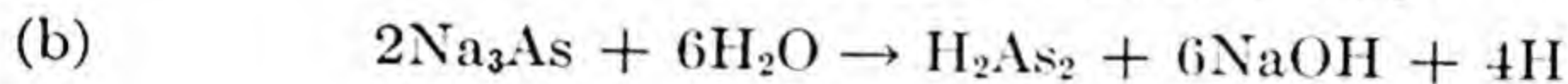
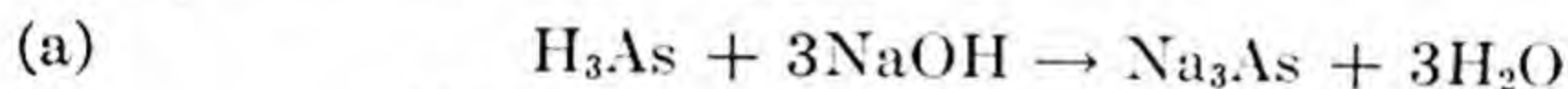
A. Brukl, Z. anorg. Chem., **131**, 236 (1923)

28



I-1599

When arsine reacts with solid sodium hydroxide, sodium arsenide and solid arsenic hydride are obtained. The same type reaction occurs with potassium hydroxide.



A. Reckleben and J. Scheiber, Z. anorg. Chem., **70**, 255 (1911)

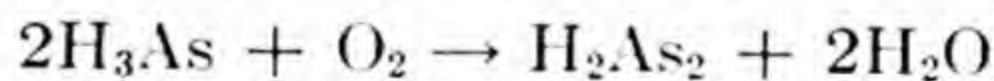
28



O

I-1600

The incomplete oxidation of arsine will yield solid arsenic hydride.



H. Reckleben and J. Scheiber, Z. anorg. Chem., **70**, 255 (1911)

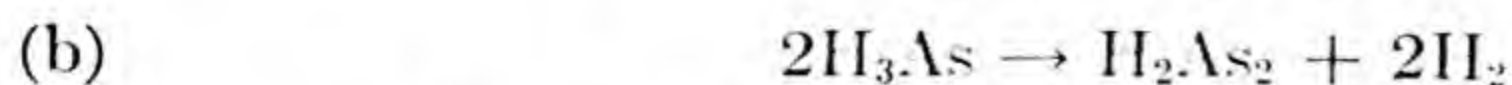
28



€

I-1601

Arsine is decomposed by silent electric discharge; metallic arsenic and solid arsenic hydride are obtained.



H. Reckleben and J. Scheiber, Z. anorg. Chem., **70**, 255 (1911)

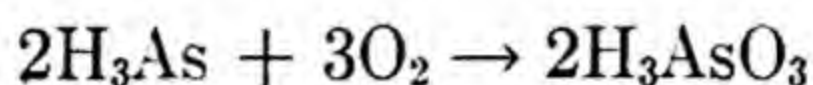
28



I-1602

Beta
Gamma } Rays

At room temperature arsine in the presence of oxygen is decomposed to arsenic, while the hydrogen is oxidized to water. Under the influence of beta and gamma rays arsenious acid is formed.

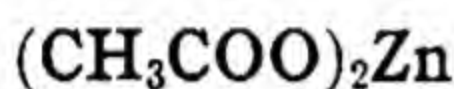


H. Reckleben and G. Lockemann, *Z. anorg. Chem.*, **92**, 145 (1915)

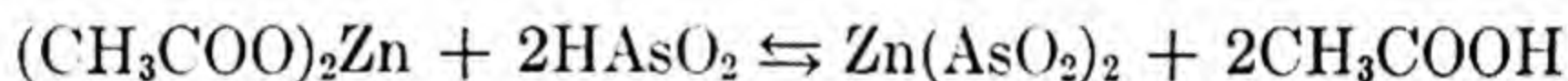
28



I-1603

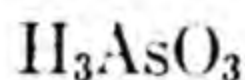


When wood is treated against decay by being impregnated with zinc acetate, acetic acid and metarsenious acid, highly toxic zinc metarsenite is precipitated.

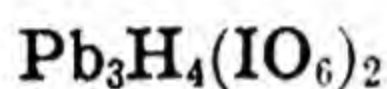


L. Curtin, *Ind. Eng. Chem.*, **21**, 707 (1929)

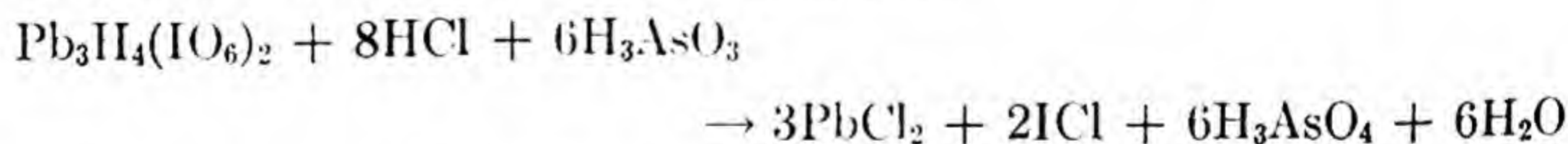
24



I-1604

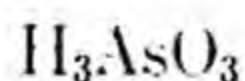


Lead paraperiodate may be determined volumetrically by the use of arsenious acid using concentrated hydrochloric acid as a solvent. If arsenious acid is present in excess, all the chlorine will react with it to form arsenic acid. The excess arsenious acid can then be titrated with iodate using chloroform as indicator.

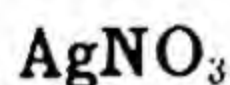


Hobart H. Willard and J. J. Thompson, *Ind. Eng. Chem., Anal. Ed.*, **6**, 425 (1934)

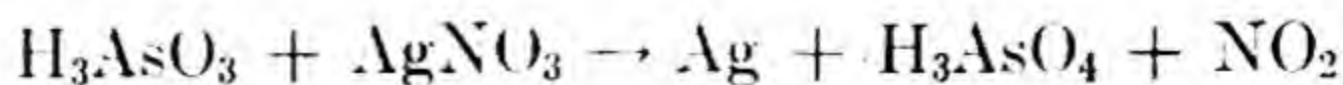
44



I-1605



An ammoniacal solution of silver nitrate is reduced to metallic silver by arsenious acid.



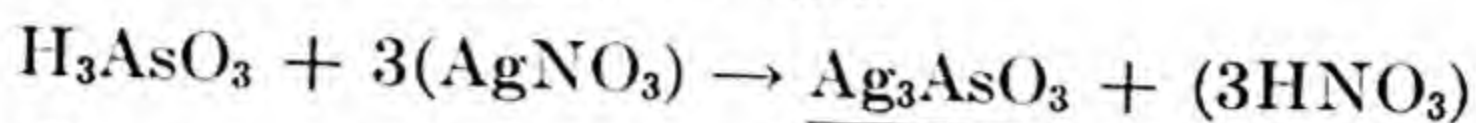
Kohn, *Monatsh.*, **43**, 367 (1923)

Ref., *J. Chem. Soc. (London)*, **124**, 238 (1923)

1

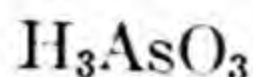
AgNO₃**I-1606**

A yellow precipitate of silver arsenite is formed when an excess of arsenious acid is treated with a silver salt.

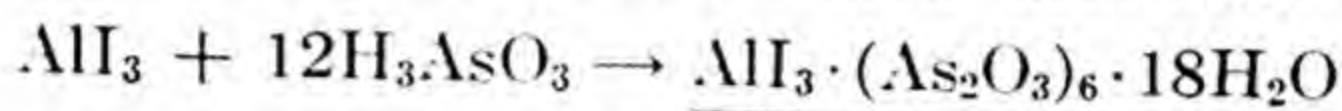


Pasteur, J. de Pharm. et de Chim., XIII, 397
Ref., Ann. **68**, 309 (1848)

1

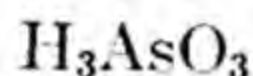
AlI₃**I-1607**

Small crystals separate when a moderately concentrated solution of aluminum iodide is saturated with arsenious acid under heating.

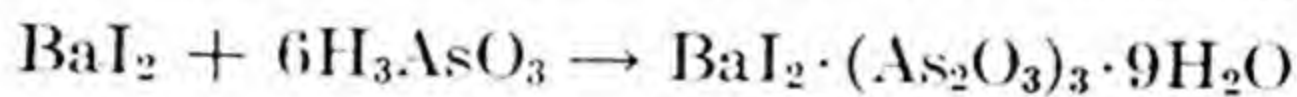


Weinland and Gruhl, Arch. Pharm., **255**, 467 (1917)
Ref., J. Chem. Soc., (London), **116**, 411 (1919)

1

BaI₂**I-1608**

Small crystals separate when a moderately concentrated solution of barium iodide is saturated with arsenious acid under heating.

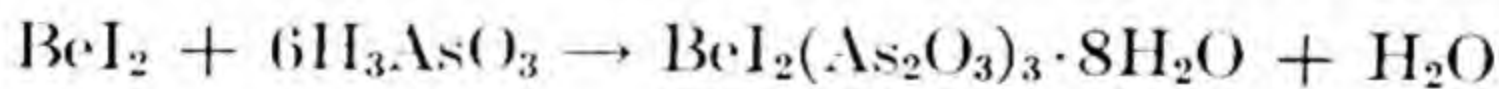


Weinland and Gruhl, Arch. Pharm., **255**, 467 (1917)
Ref., J. Chem. Soc. (London), **116**, 411 (1919)

1

BeI₂**I-1609**

Small crystals separate when a moderately concentrated solution of beryllium iodide is saturated with arsenious acid under heating.

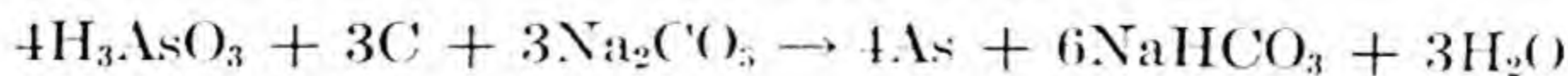


Weinland and Gruhl, Arch. Pharm., **255**, 467 (1917)
Ref., J. Chem. Soc. (London), **116**, 411 (1919)

1

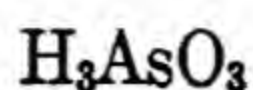
C**I-1610**

Arsenious acid is reduced to metallic arsenic when heated to redness with a mixture of coal and sodium carbonate.



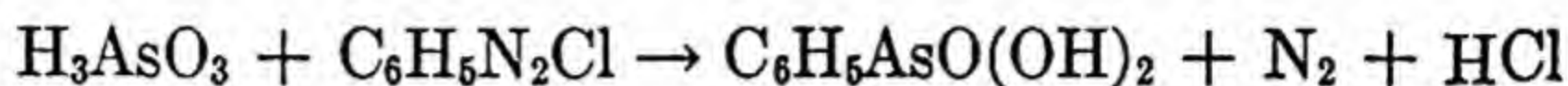
Boutigny, Ann., **8**, 151 (1833)

20



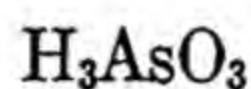
I-1611

Arsenious acid reacts in a neutral solution with phenyl diazonium chloride to form phenyl arsenic acid, free nitrogen and hydrochloric acid.



W. L. Lewis, Ind. Eng. Chem. **15**, 19 (1923)

23



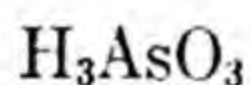
I-1612

Arsenious acid reacts in a slightly alkaline solution with phenyl diazonium hydroxide and forms phenyl arsenic acid, free nitrogen and water.



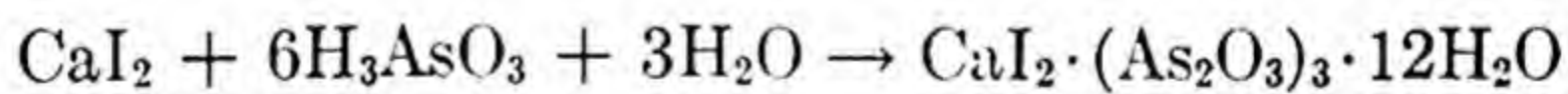
W. L. Lewis, Ind. Eng. Chem. **15**, 19 (1923)

23



I-1613

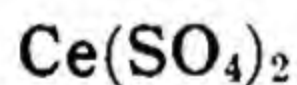
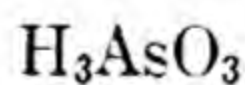
Small crystals separate when a moderately concentrated solution of calcium iodide is saturated with arsenious acid under heating.



Weinland and Gruhl, Arch. Pharm., **255**, 467 (1917)

Ref., J. Chem. Soc. (London), **116**, 411 (1919)

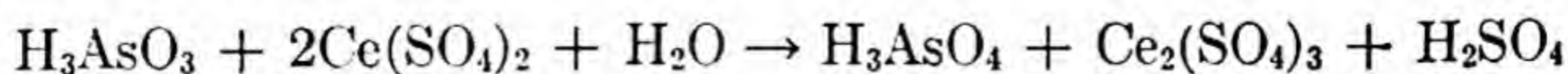
1



I-1614



The reaction between arsenious acid and ceric sulfate is catalyzed by very small amounts of osmium tetroxide.



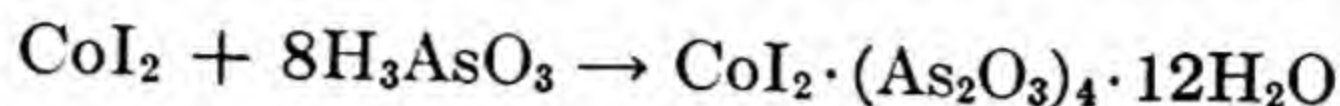
Glen, Z. Anal. Chem., **95**, 305 (1933)

Ref., Willard and Young, Ind. Eng. Chem., Anal. Ed., **7**, 57 (1935)

33

CoI₂**H₃AsO₃****I-1615**

Small crystals separate when a moderately concentrated solution of cobaltous iodide is saturated with arsenious acid under heating.

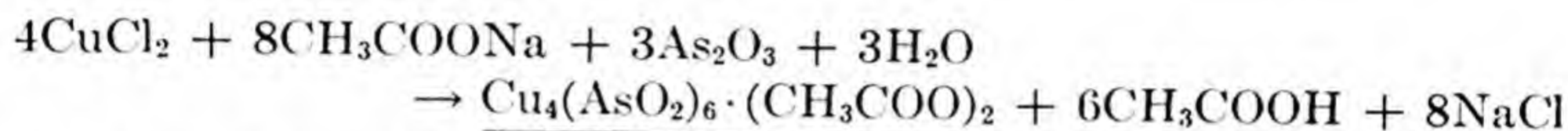


Weinland and Gruhl, *Arch. Pharm.*, **255**, 467 (1917)
 Ref., *J. Chem. Soc.*, (London), **116**, 411 (1919)

1

H₃AsO₃**CuCl₂****I-1616**

When a solution containing cupric chloride, sodium acetate and arsenious acid is evaporated, the following reaction takes place to form Paris green.

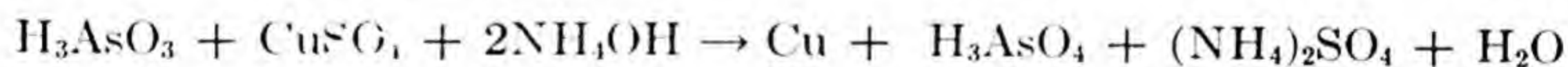


L. P. Curtin, *Ind. Eng. Chem.*, **19**, 994 (1927)

23

H₃AsO₃**CuSO₄****I-1617**

A solution of cupric sulfate is reduced to copper by arsenious acid in the presence of aqueous ammonia.



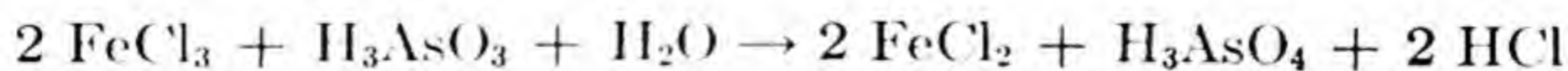
Kohn, *Monatsh.*, **43**, 367 (1923)

Ref., *J. Chem. Soc.*, (London), **124**, 238 (1923)

1

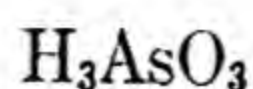
H₃AsO₃**FeCl₃****I-1618**

The kinetics and equilibrium of the oxidation of arsenous acid to arsenic acid by a ferric salt are studied:



K. Jellineck and L. Winogradoff, *Z. Elektrochem.* **30**, 477, 479, 483, 490 (1924)

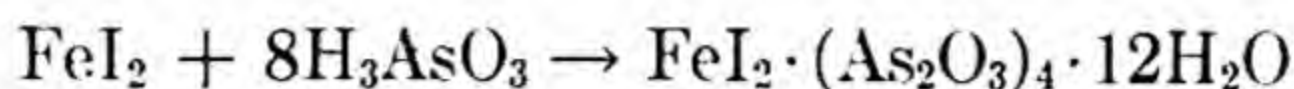
86



FeI₂

I-1619

Small crystals of a complex salt separate when a moderately concentrated solution of ferrous iodide is saturated with arsenious acid under heating.



Weinland and Gruhl, *Arch. Pharm.*, **255**, 467 (1917)

Ref., *J. Chem. Soc. (London)*, **116**, 411 (1919)

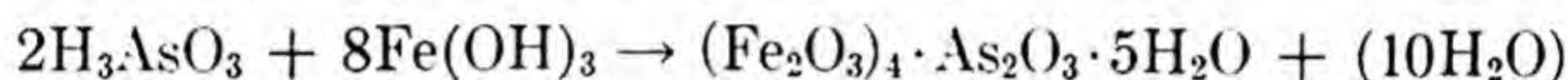
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Fe(OH)₃

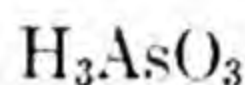
I-1620

A precipitate is formed when arsenious acid is treated with freshly precipitated ferric hydroxide.



Biltz, *Ber.*, **37**, 3138 (1904)

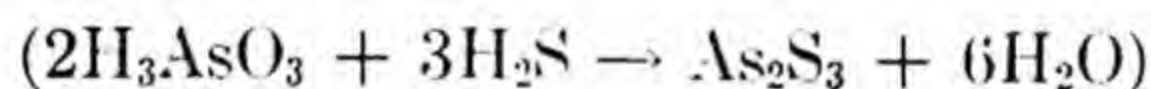
25



H₂S

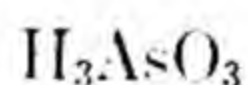
I-1621

Arsenic trisulfide may be precipitated by passing a current of hydrogen sulfide through arsenious acid.



Wöhler, *Chem. News*, **1**, 53 (1867)

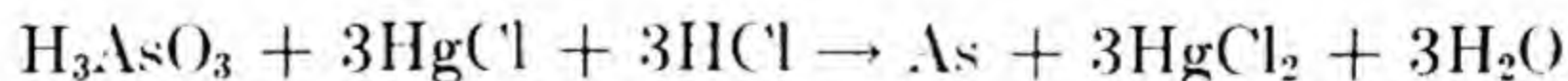
101



HgCl

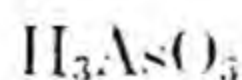
I-1622

Arsenic is precipitated from solutions of arsenious acid by mercurous chloride dissolved in concentrated hydrochloric acid solutions (30% or higher). No precipitation occurs if the HCl concentration is below 20%.



Pierson, *Ind. Eng. Chem., Anal. Ed.*, **6**, 437 (1934)

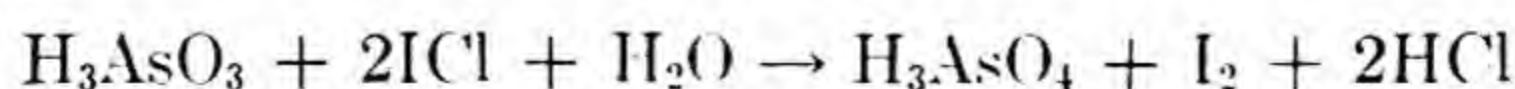
33



ICl

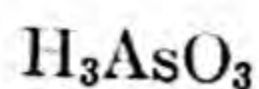
I-1623

Iodine monochloride oxidizes arsenious acid.



Swift and Gregory: *J. Am. Chem. Soc.* **52**, 901 (1930)

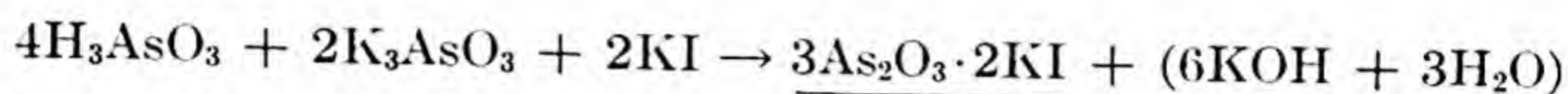
1



I-1624



A white crystalline double salt is formed when potassium arsenite exactly neutralized with dilute arsenious acid is treated with potassium iodide.



J. Emmet: Sillim. J. [I.], **18**, 58 (1830); Ann. **228**, 72 (1885)

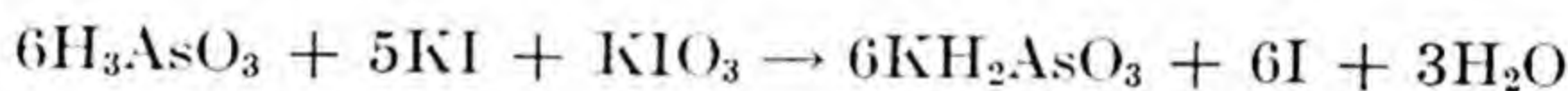
25



I-1625



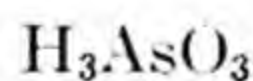
Potassium dihydrogen arsenite is formed when arsenious acid is treated with potassium iodide and iodate mixture.



L. Brandt, Chem. Ztg., **37**, 1445, 1471, 1496 (1913)

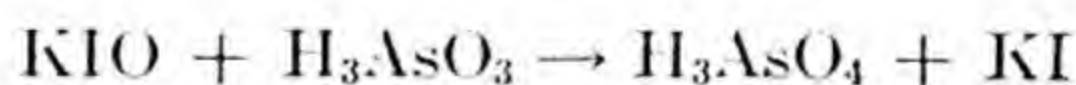
Ref., Z. Anal. Chem., **58**, 447 (1919)

28



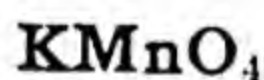
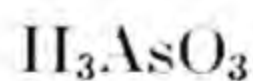
I-1626

If arsenious acid is reacted with potassium hypoiodite it is oxidized to arsenic acid and the iodide remains.



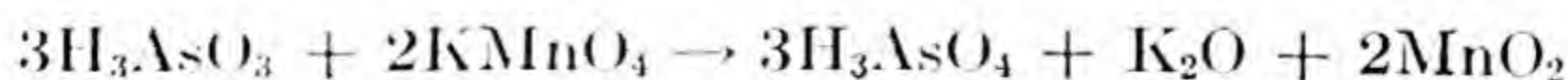
Orton and Blackman, J. Chem. Soc., (London), **77**, 830 (1900)

103



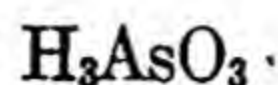
I-1627

When a solution of potassium permanganate is added to arsenious acid, the latter is converted into arsenic acid.

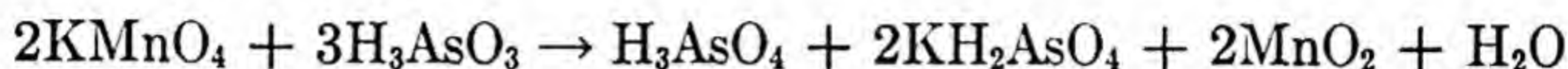


Bussy, Compt. Rend. **24**, 774 (1847)

29

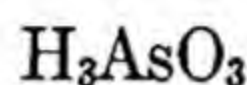
**KMnO₄****I-1628**

Arsenious acid or arsenites in either acid or alkaline solution can be titrated with potassium permanganate, with the formation of arsenic acid (or arsenates).

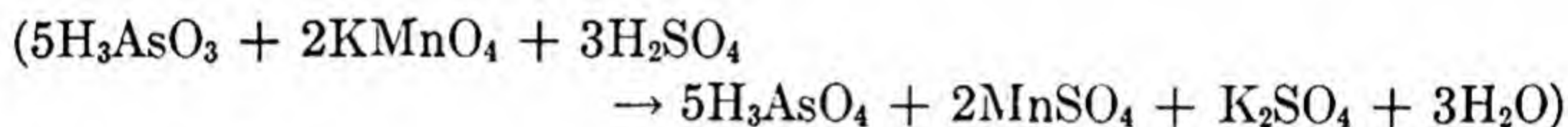


Sait-Giles, *Compt. Rend.*, **48**, 627 (1858)

29

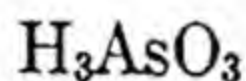
**KMnO₄****I-1629****(KI)**

In the reaction between arsenite and permanganate in acid solution, the manganese is reduced to the bivalent state. The reduction of the manganese to manganous ion is apparently catalyzed by dilute potassium iodate, potassium iodide, iodine monochloride and osmium tetroxide.

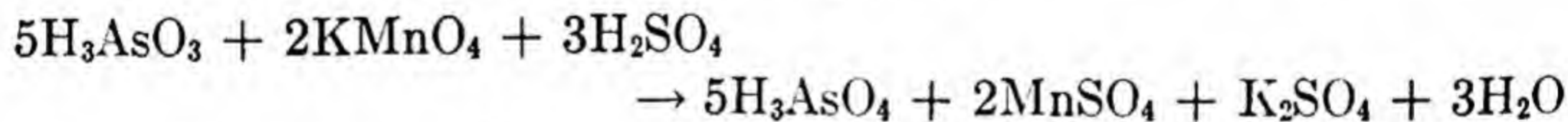


Park, *Ind. Eng. Chem., Anal. Ed.*, **7**, 427 (1935)

33

**KMnO₄****I-1630****(OsO₄)**

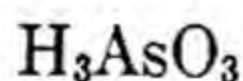
Very small amounts of osmium tetroxide catalyze the reaction between arsenious acid and potassium permanganate.



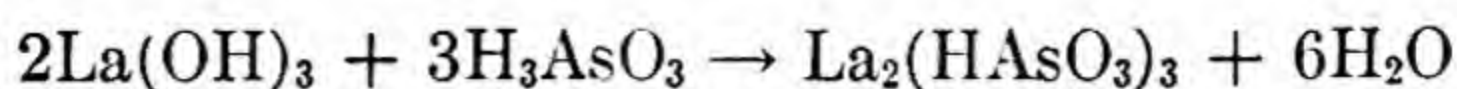
Glen, *Z. Anal. Chem.*, **95**, 305 (1933)

Ref., Willard and Young, *Anal. Ed.*, **7**, 57 (1935)

33

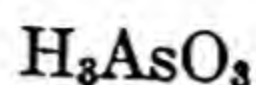
**La(OH)₃****I-1631**

An aqueous solution of arsenious acid and one of lanthanum hydroxide are heated together for many hours. Lanthanum hydrogen arsenite is produced.

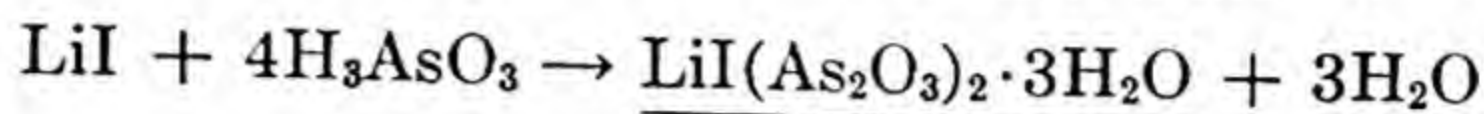


F. Frerichs and F. Smith, *Ann.*, **191**, 363 (1878)

20

**LiI****I-1632**

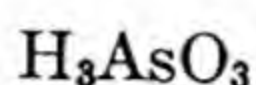
Small crystals separate when a moderately concentrated solution of lithium iodide is saturated with arsenious acid under heating.



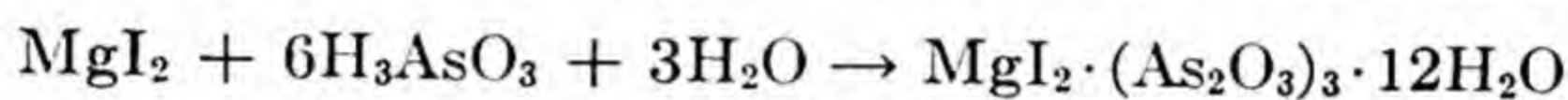
Weinland and Gruhl, Arch. Pharm., **255**, 467 (1917)

Ref., J. Chem. Soc. (London), **116**, 411 (1919)

1

**MgI₂****I-1633**

Small crystals separate when a moderately concentrated solution of magnesium iodide is saturated with arsenious acid under heating.



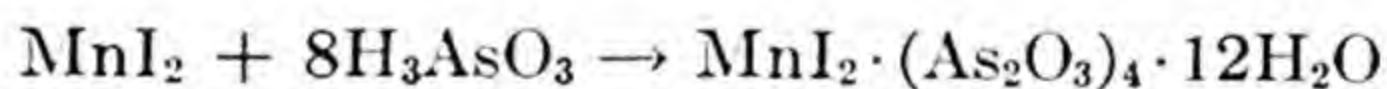
Weinland and Gruhl, Arch. Pharm., **255**, 467 (1917)

Ref., J. Chem. Soc. (London), **116**, 411 (1919)

1

**MnI₂****I-1634**

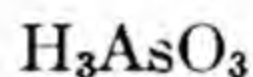
Small crystals separate when a moderately concentrated solution of manganous iodide is saturated with arsenious acid under heating.



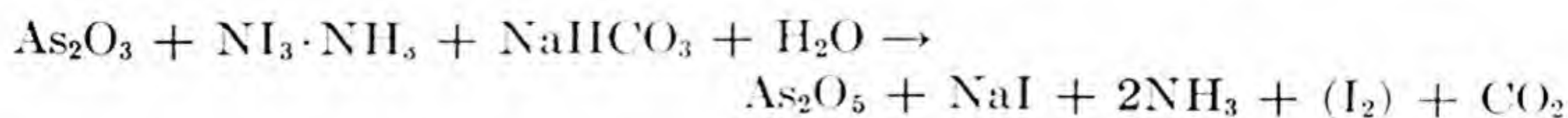
Weinland and Gruhl, Arch. Pharm., **255**, 467 (1917)

Ref., J. Chem. Soc., (London), **116**, 411 (1919)

1

**N₂H₃I₃****I-1635****NaHCO₃**

Arsenic pentoxide, ammonia and free iodine are formed when arsenious acid is treated with nitrogen triiodide monammoniate in sodium bicarbonate solution.



Chattaway and Stevens, Am. Chem. J., **23**, 372 (1900)

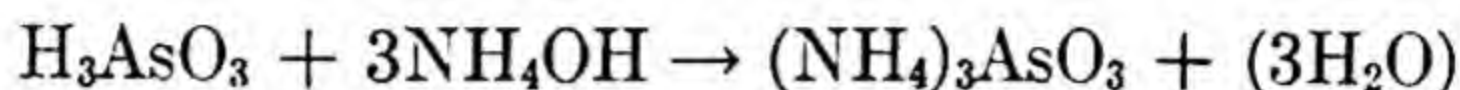
1



NH₄OH

I-1636

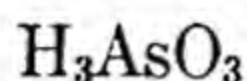
Ammonium arsenite is obtained when arsenious acid is treated with a strong solution of ammonium hydroxide.



Pasteur, J. Pharm. et de Chim., **13**, 397 (1848)

Ref., Ann., **68**, 308 (1848)

25

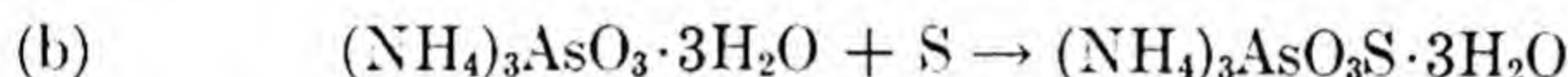


NH₄OH

I-1637

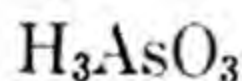
S

One obtains shining leaflets of ammonium monothioarsenate when finely powdered arsenious acid dissolved in ammonium hydroxide is treated with precipitated sulfur and warmed on the water bath.



Weinland and Rumpf, Z. anorg. Chem., **14**, 42 (1897)

28

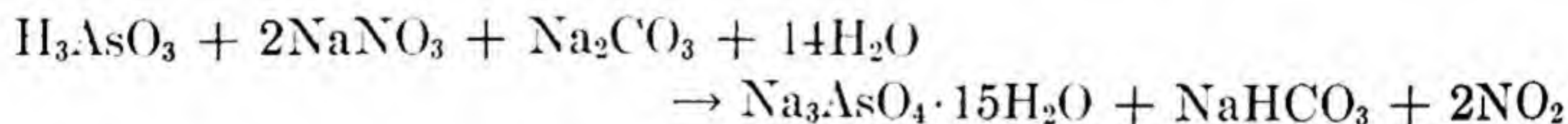


NaNO₃

I-1638

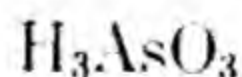
Na₂CO₃

Large efflorescent crystals of hydrated sodium arsenate are formed when a mixture consisting of two hundred parts of sodium nitrate and one hundred sixteen parts of arsenious acid is heated to redness in a crucible, treated with sodium carbonate until alkaline and evaporated to crystallization.



H. Lescœur, Ann. chim. phys., **21**, 554 (1890)

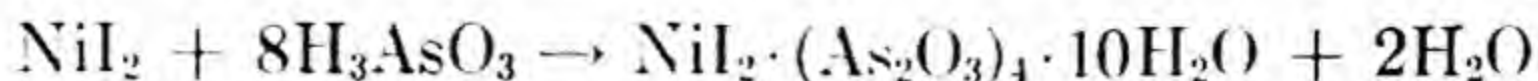
70



NiI₂

I-1639

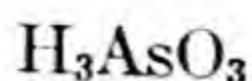
Small crystals separate when a moderately concentrated solution of nickel iodide is saturated with arsenious acid under heating.



Weinland and Gruhl, Arch. Pharm., **255**, 467 (1917)

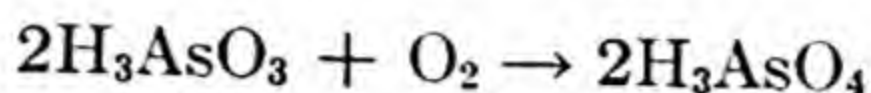
Ref., J. Chem. Soc. (London), **116**, 411 (1919)

57

O₂

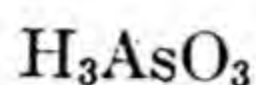
I-1640

Oxygen under pressure will react with a suspension of arsenious acid in 40%-60% nitric acid yielding arsenic acid.



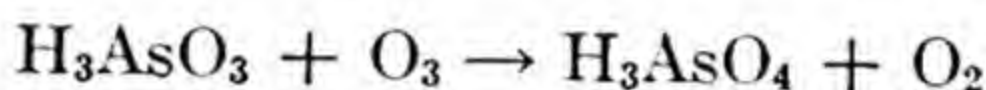
H. Zieler, Z. anorg. Chem., **162**, 161 (1927)

28

O₃

I-1641

The oxidation of arsenious acid, acidified with hydrochloric acid, by ozone to arsenic acid can be used as a means of analysis for ozone.



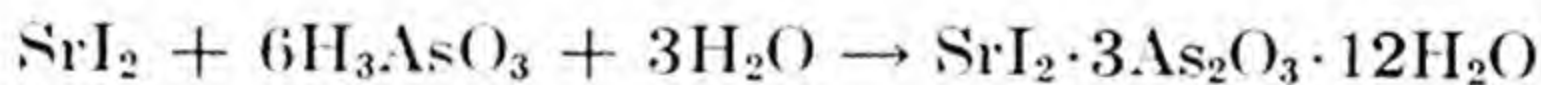
P. Thenaud, Compt. Rend., **75**, 175 (1872)

29

SrI₂

I-1642

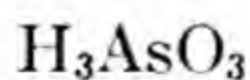
Small crystals separate when a moderately concentrated solution of strontium iodide is treated with arsenious acid under heating.



Weinland and Gruhl, Arch. Pharm., **255**, 467 (1917)

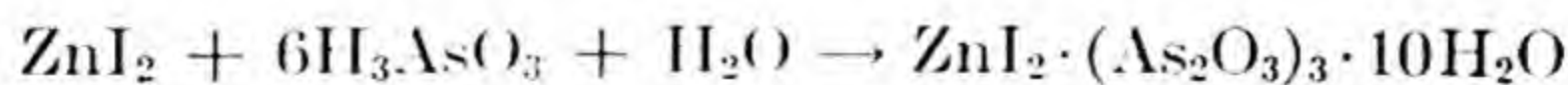
Ref., J. Chem. Soc., (London), **116**, 411 (1919)

1

ZnI₂

I-1643

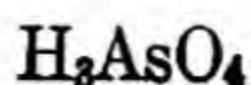
Small crystals separate when a moderately concentrated solution of zinc iodide is saturated with arsenious acid under heating.



Weinland and Gruhl, Arch. Pharm., **255**, 467 (1917)

Ref., J. Chem. Soc. (London), **116**, 411 (1919)

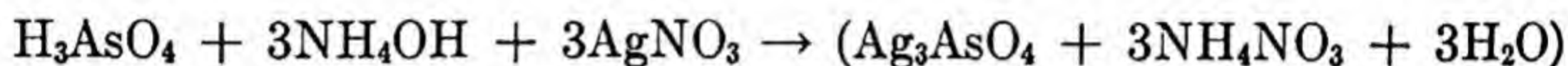
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I-1644

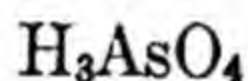


To detect less than 0.001 mg. arsenic, convert to arsenic acid by means of nitric acid. Carefully evaporate to dryness one drop of the solution on a microscope slide. Cover the residue with one drop of reagent (3% AgNO_3 + 1/5 of its volume 7-8N NH_4OH). Red hexagonal or rhombic, sometimes tetragonal crystals form even when minute quantities of arsenic are present. These may be observed under the microscope. The same delicate test may be carried out with 3% AgNO_3 and 1/10 of its volume of acetic acid as reagent yielding the same type of crystals.



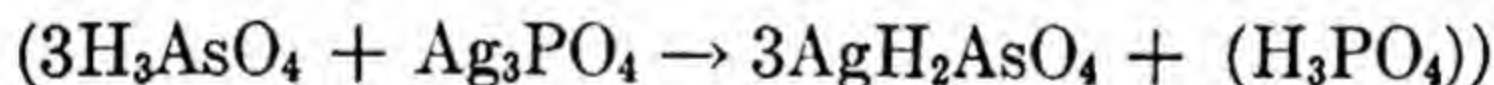
G. Deniges, *Compt. rend.*, **147**, 596-7 (1908)

38



I-1645

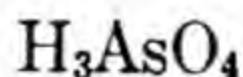
Colorless prisms of silver dihydrogen arsenate are formed when arsenic acid solution (one part of acid to one part of water) is treated with silver phosphate.



A. Joly, *Compt. rend.*, **103**, 1071

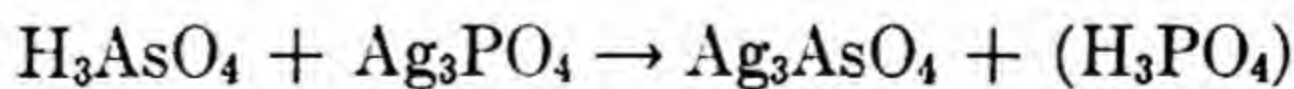
Ref., *Ber.*, **20**, 6 (1887)

1



I-1646

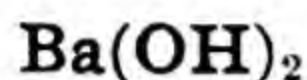
Black opaque shiny crystals of silver arsenate are formed when a solution of arsenic (70 parts of acid to 100 parts of water) is saturated with amorphous silver phosphate at 80° and cooled.



A. Joly, *Compt. rend.* **103**, 1071

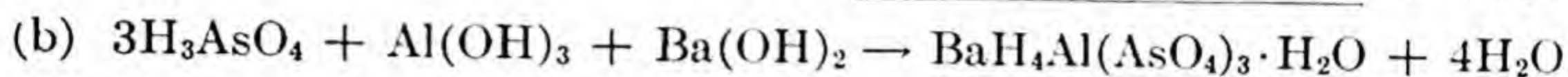
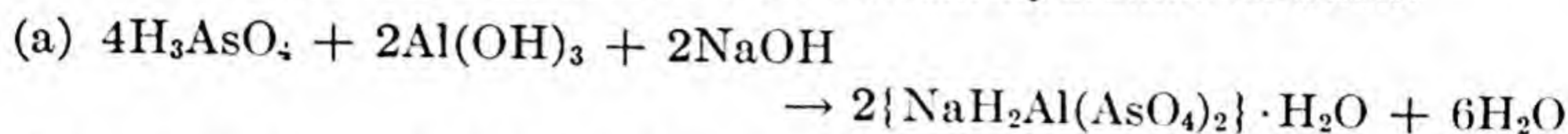
Ref., *Ber.*, **20**, 6 (1887)

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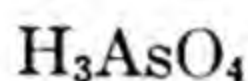
I-1647

By heating arsenic acid with aluminum hydroxide and sodium hydroxide in a sealed tube at 180° aluminum-sodium-arsenate is obtained. The same type reaction occurs with barium hydroxide solution.



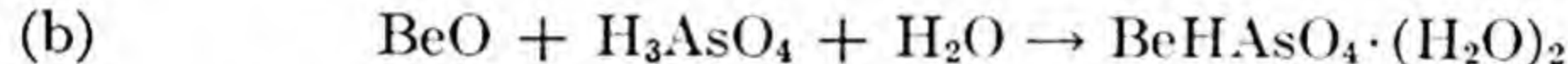
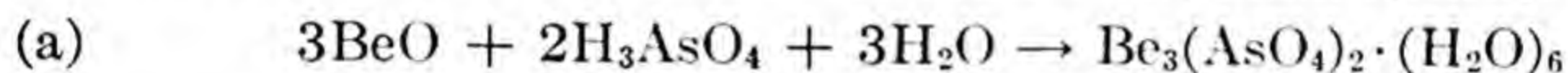
A. Rosenheim and S. Thon, *Z. anorg. Chem.*, **167**, 1 (1927)

28



I-1648

A solution of beryllium oxide in arsenic acid yields, on addition of alcohol, a white, gelatinous precipitate, sometimes hexahydrated triberyllium arsenate, and sometimes dihydrated beryllium hydrogen arsenate.



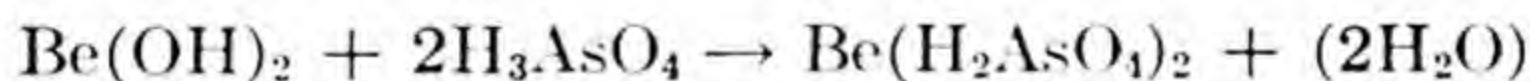
A. Atterberg, *K. Sv. Vet. Akad. Handl. Öfvers.* **32**, 7, 35 (1875)

10



I-1649

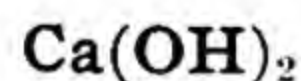
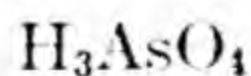
Monoberyllium arsenate is formed when the calculated quantity of beryllium hydroxide is dissolved in arsenic acid.



Bleyer and Müller, *Z. Anorg. Chem.*, **75**, 285

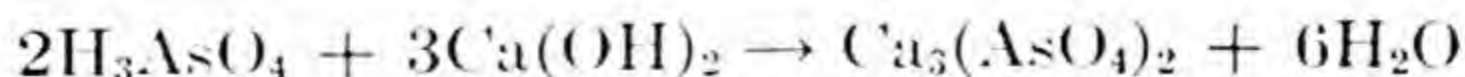
Ref., J. L. Howe, *J. Am. Chem. Soc.*, **35**, 187 (1913)

1



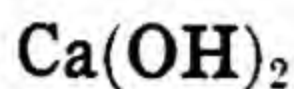
I-1650

Tricalcium arsenate is formed from the reaction of arsenic acid and a slurry of slaked lime.



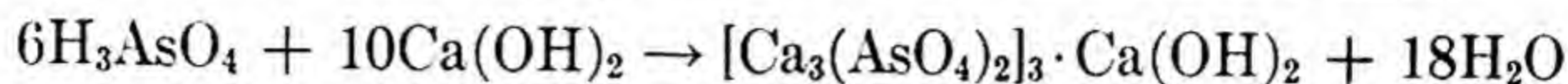
C. W. Drury and C. W. Simmons, *Can. Chem. Met. Eng.*, **9**, 179 (1925)

15



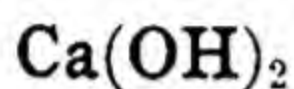
I-1651

Lime and arsenic acid may produce a basic calcium arsenate.



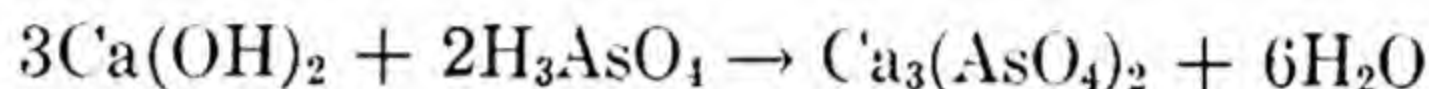
Tailor, Wood and Hiner, J. Am. Chem. Soc. **36**, 809 (1924)

Ref., C. W. Drury and C. W. Simmons, Can. Chem. & Met., **9**, 180 (1924) 15

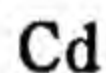
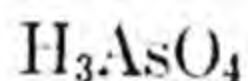


I-1652

If arsenic acid is poured on a paste of slaked lime, tricalcium arsenate is formed.

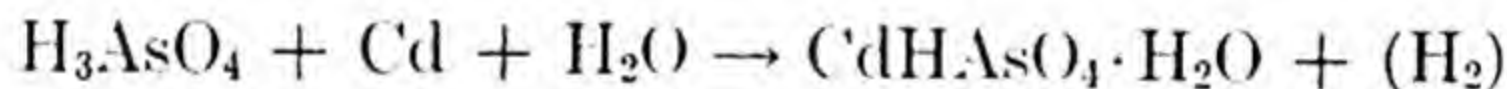


Reedy and Haag, J. Ind. Eng. Chem. **13**, 1038 (1921) 22



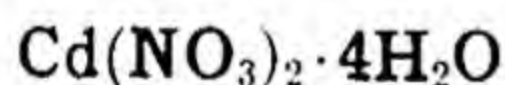
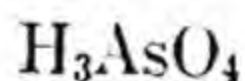
I-1653

Cadmium hydrogen arsenate is formed when cadmium is dissolved in arsenic acid at 200° and the resulting solution treated with water.

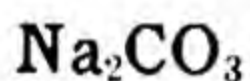


Coloriano, Compt. rend., **103**, 273

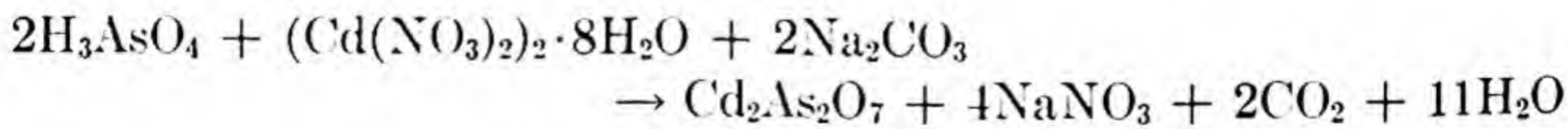
Ref., Ber., **19**, 660 (1886) 25



I-1654



A mixture of ortho arsenic acid (22.5g) with cadmium nitrate (48.9g) and sodium carbonate (9.1g) in 300 cc of water is heated in an autoclave equipped with a mixer at a temperature of 180°. Crystals of cadmium pyroarsenate are formed.

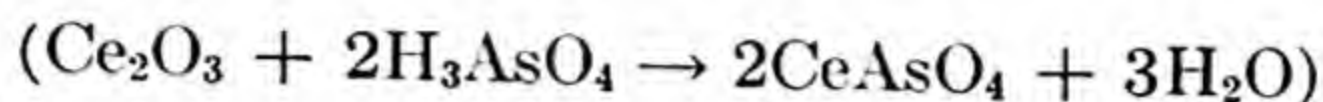


A. Rosenheim, Z. anorg. Chem. **193**, 73 (1930) 28



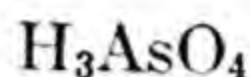
I-1655

When cerium oxide is digested with arsenic acid there forms a difficultly soluble salt, probably cerium arsenate, which dissolves in an excess of arsenic acid.



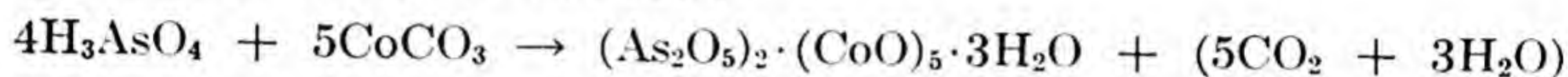
W. Hisinger and J. Berzelius, *Avhandl. i Fysik, Kemi och Min.*, **1**, 75 (1806)

10



I-1656

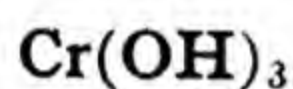
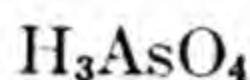
Reddish needles are obtained when cobaltous carbonate is digested with an excess of arsenic acid at 235°.



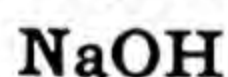
Coloriano, *Compt. rend.*, **103**, 273

Ref., *Ber.*, **19**, 660 (1886)

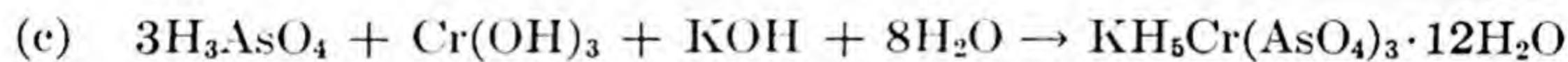
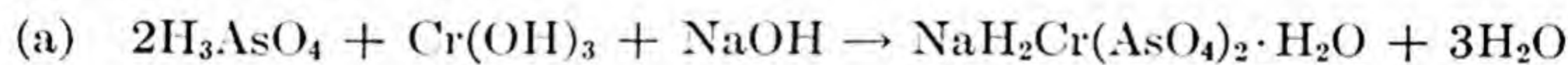
25



I-1657

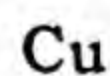
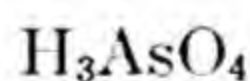


By heating arsenic acid with chromium, hydroxide and sodium hydroxide in a sealed tube for 6 hours at 180° green colored crystals of sodium-chromium-arsenate are obtained. The same type reaction occurs with potassium hydroxide.



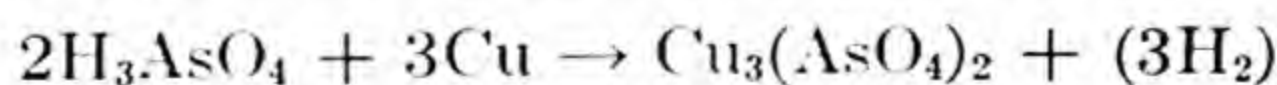
A. Rosenheim and S. Thon, *Z. anorg. Chem.*, **167**, 1 (1927)

28



I-1658

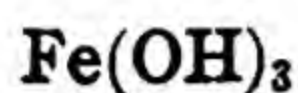
Dark reddish, blue olive colored triclinic needles of cupric arsenate are obtained when arsenic acid reacts with copper at 180°.



Coloriano, *Compt. rend.*, **103**, 273

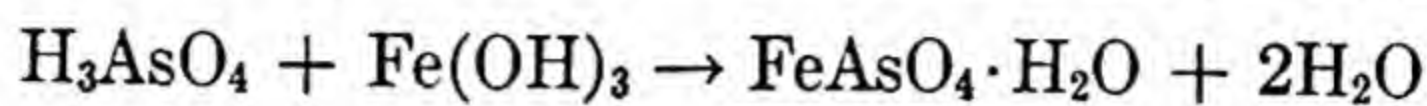
Ref., *Ber.*, **19**, 660 (1886)

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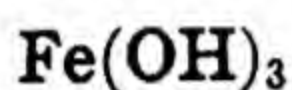
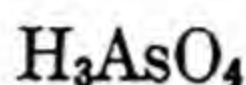
I-1659

By heating arsenic acid with ferric hydroxide in a sealed tube for 5 hours at 160° white crystals of ferric arsenate are obtained.

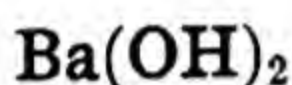


A. Rosenheim and S. Thon, *Z. anorg. Chem.*, **167**, 1 (1927)

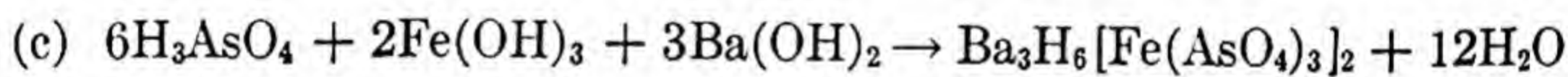
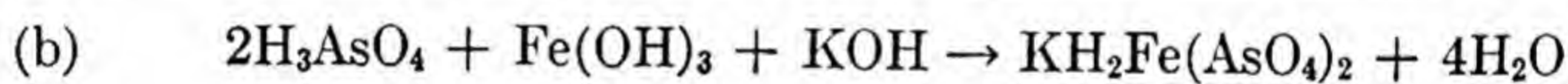
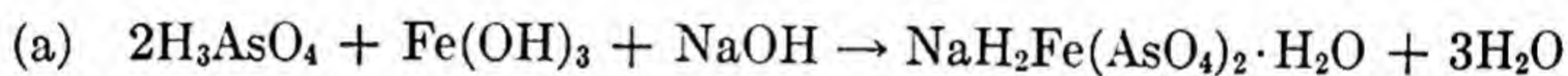
28



I-1660



By heating in a sealed tube at 180–200° 30 grams of arsenic acid with 50 cc water and ferric hydroxide obtained from 2.7 grams of crystallized ferric chloride and 4 grams of sodium hydroxide, sodium-ferric-arsenate, in form of white crystals, is obtained. The same type reaction occurs with potassium hydroxide and barium hydroxide.



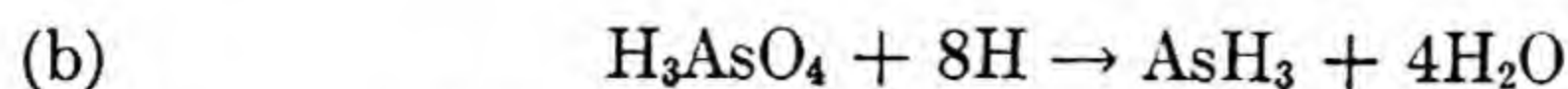
A. Rosenheim and S. Thon, *Z. anorg. Chem.*, **167**, 1 (1927)

28



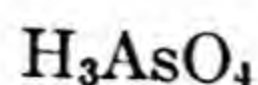
I-1661

Active hydrogen in contact with certain metals reduces arsenic acid to elemental arsenic. In the presence of a zinc-copper couple arsine is formed.



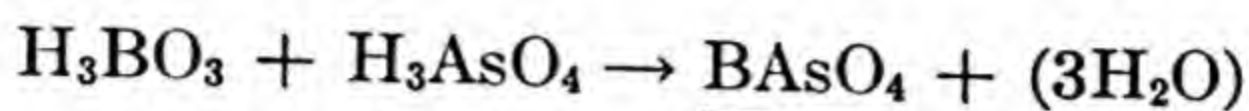
Gladstone and Tribe, *J. Chem. Soc.*, **33**, 306, (1878)

91



I-1662

Boron arsenate is produced when arsenic acid, heated to boiling, is treated with boric acid and the solution maintained at the boiling point for a time.



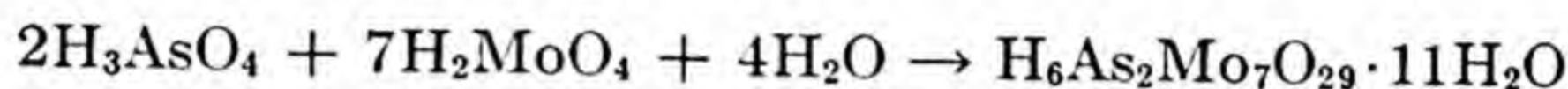
Schumb and Hartford, J. Am. Chem. Soc., **56**, 2646 (1934)

1



I-1663

When molybdic and arsenic acids are concentrated together they form a complex arseno molybdic acid.



H. Seyberth, Ber., **7**, 391 (1874)

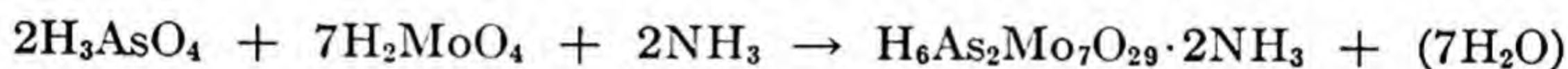
11



I-1664



When ammonium hydroxide is added to a boiling solution of molybdic and arsenic acids, a complex salt is formed.

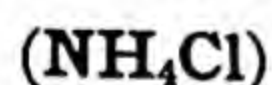


H. Seyberth, Ber., **7**, 391 (1874)

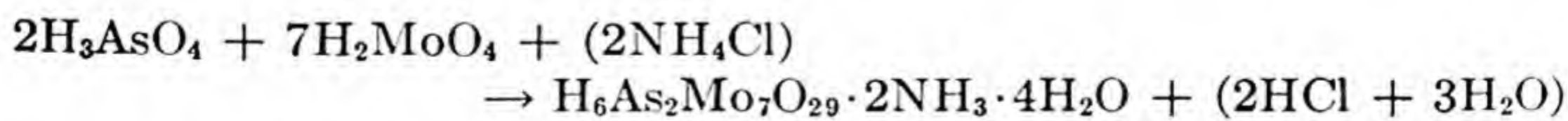
11



I-1665



A precipitate consisting of small crystals is formed when a solution of molybdic acid and arsenic acid in the presence of an ammonium salt is heated to boiling for a long time.



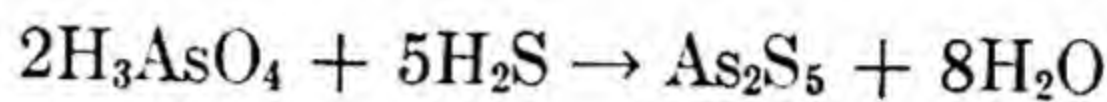
H. Seyberth, Ber., **7**, 391 (1874)

25


 H_2S

I-1666

Arsenic acid can be determined quantitatively by passing hydrogen sulfide through an acid solution thereby converting it to arsenic pentasulfide which is precipitated and can be weighed.



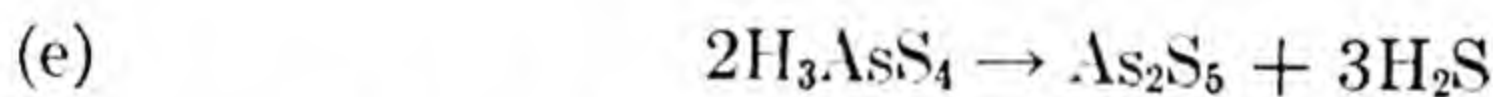
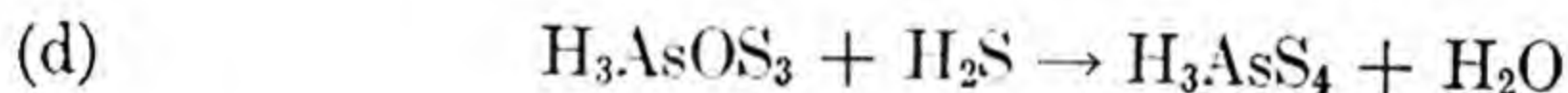
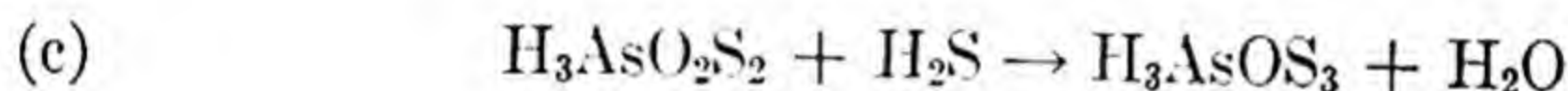
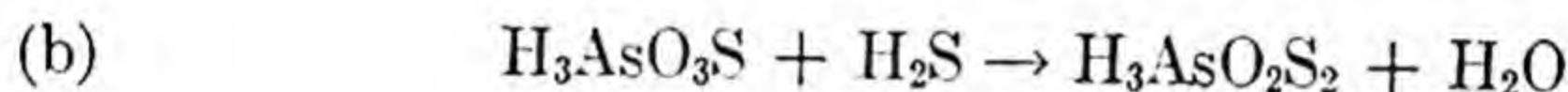
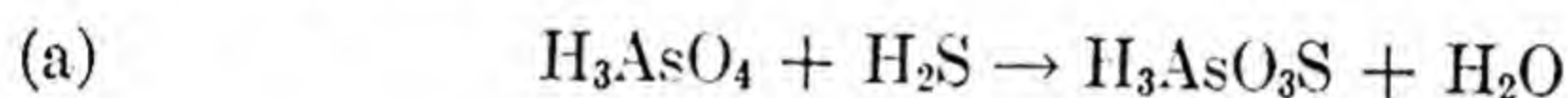
Leroy W. McCay, *Am. Chem. J.*, **9**, 177 (1887)

17


 H_2S

I-1667

Arsenic pentasulfide is obtained when a fast moving stream of hydrogen sulfide is passed through a solution of (ortho) arsenic acid. The gas is always in excess.

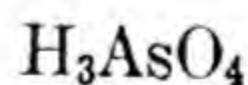


LeRoy W. McCay, *Z. anorg. Chem.*, **29**, 36 (1902)

28

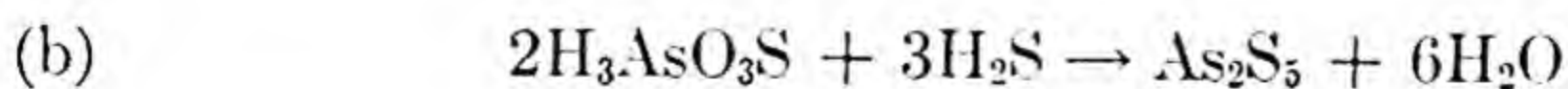
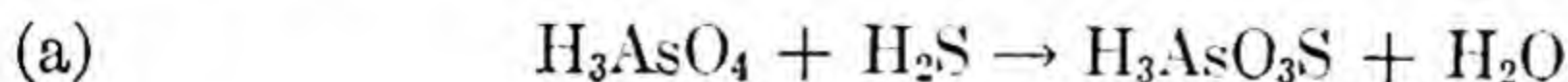
Ref., Glatzel, *Z. anorg. Chem.*, **70**, 86 (1911)

25


 H_2S

I-1668

If a limited amount of hydrogen sulfide is added to a solution of arsenic acid, monothioarsenic acid is formed. If, however, larger amounts of hydrogen sulfide are added arsenic pentasulfide is precipitated.

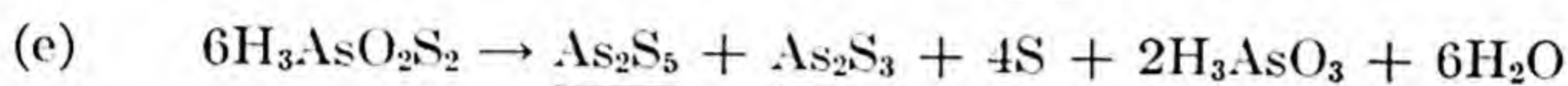
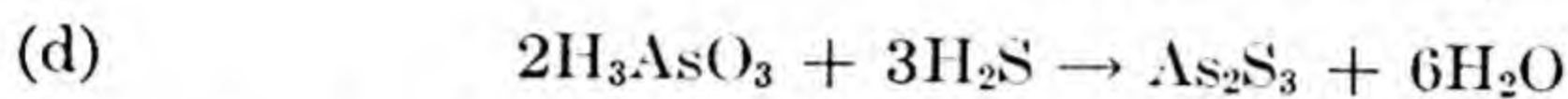
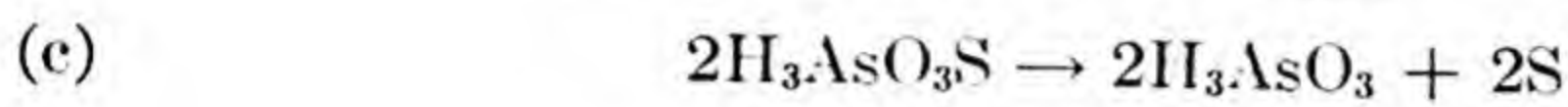
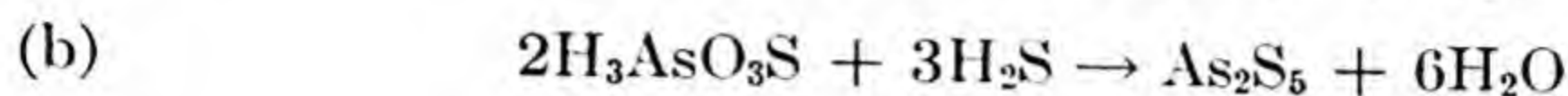
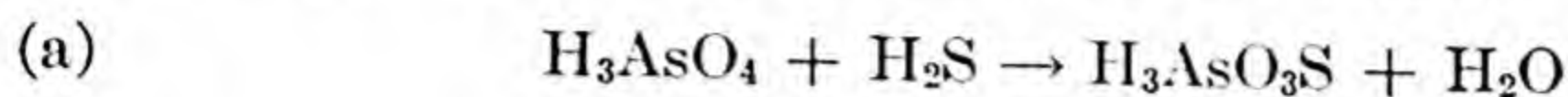


Bohuslav Brauner, *J. Chem. Soc. (London)*, **67**, 532 (1895)

103

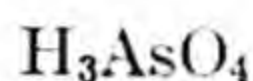
**H₂S****I-1669**

Arsenic pentasulfide, arsenic trisulfide, sulfur and arsenious acid are obtained when hydrogen sulfide is slowly passed through a solution of arsenic acid. The gas is not to be used in excess.

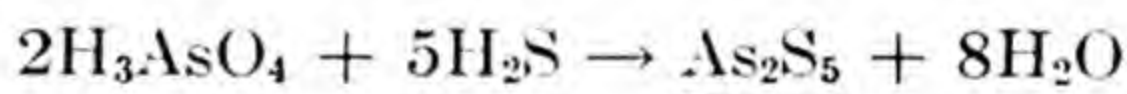


LeRoy W. McCay, *Z. anorg. Chem.*, **29**, 36 (1902)

28

**H₂S****I-1670**

Arsenic pentasulfide is precipitated very slowly from cold, dilute acid solutions of arsenic acid or an arsenate by hydrogen sulfide. At 90°C. precipitation is rapid in 0.3 *N* hydrochloric acid.

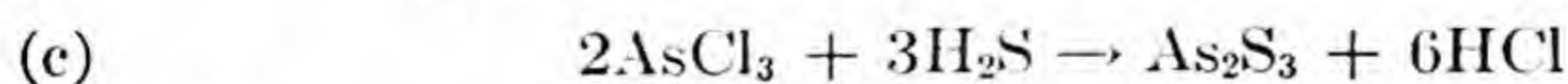


Hall and Woodward, *Ind. Eng. Chem., Anal. Ed.*, **6**, 478 (1935)

33

**H₂S****I-1671****HCl**

Ortho arsenic acid will react with hydrogen sulfide in hydrochloric acid solution, yielding arsenious sulfide.



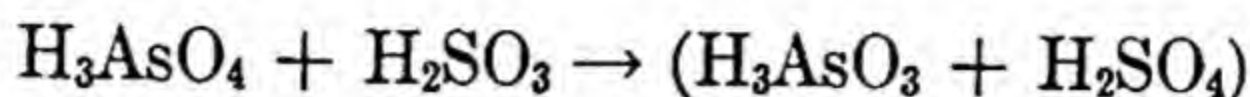
LeRoy W. McCay, *Z. anal. Chem.* **27**, 632 (1888)

28



I-1672

Arsenic acid is quickly and completely reduced by sulfurous acid in the presence of hydrobromic acid.



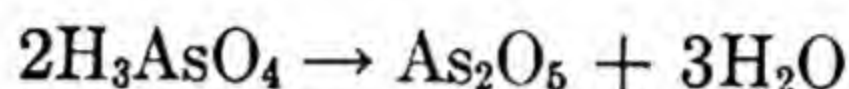
Rohmer: Ber., **34**, 1565 (1901)

25



I-1673

Arsenic acid is dehydrated to the pentoxide on evaporating to fumes with sulfuric acid.

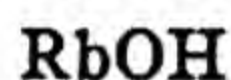


C. Schultz-Sellack, Ber., **4**, 112 (1871)

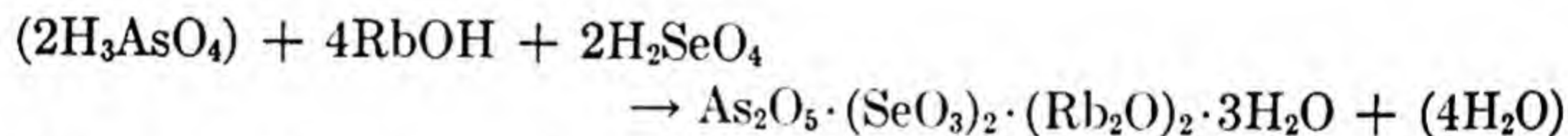
11



I-1674

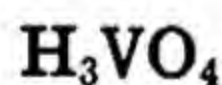


Rubidium seleno monoarsenate is obtained if a solution of selenic acid, arsenic acid, and rubidium hydroxide is concentrated on the water bath and allowed to cool.



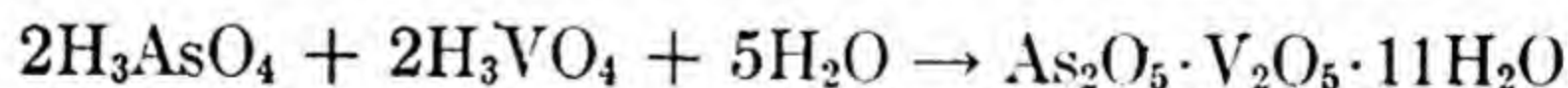
Weinland and Barttlingek, Ber., **36**, 1397 (1903)

25



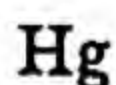
I-1675

Arsenic-vanadic acid is formed when a mixture of pure vanadic acid and concentrated arsenic acid is boiled for several hours.



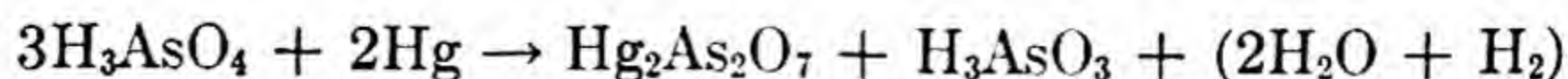
P. Fernandez: Ber., **17**, 1632 (1884)

25



I-1676

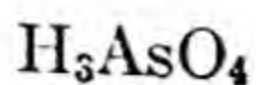
A yellow mercuric pyroarsenate is formed when mercury is heated with dry arsenic acid.



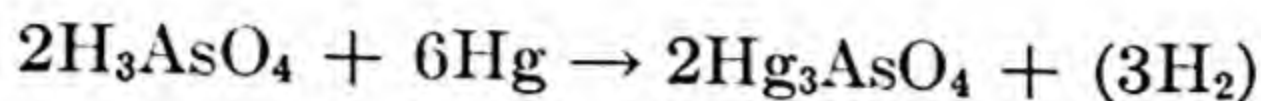
Gmelin,

Ref., M. Dunschmann and H. v Pechmann, Ann., **262**, 181 (1891)

25

**Hg****I-1677**

Mercurous arsenate is formed when mercury dissolves in arsenic acid at 230°.



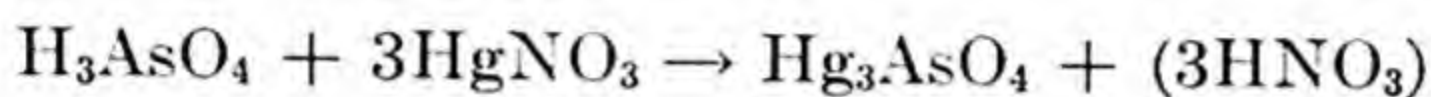
Coloriano, Compt. rend., **103**, 273

Ref., Ber., **19**, 660 (1886)

25

**HgNO₃****I-1678**

Mercurous arsenate is formed when mercurous nitrate is dropped into a solution of arsenic acid.

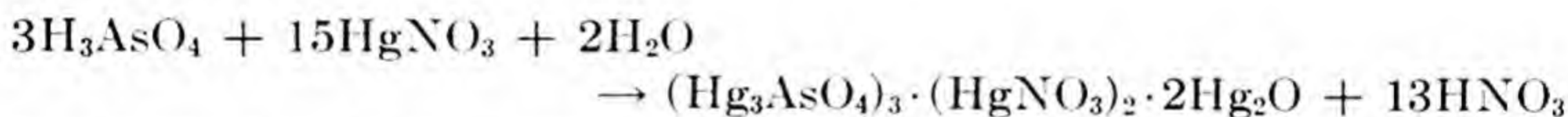


K. Haack: Ann., **262**, 190 (1891)

1

**HgNO₃****I-1679**

A complex salt is formed when an excess of mercurous nitrate is added to arsenic acid.

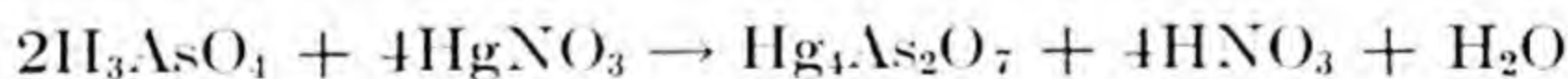


K. Haack: Ann., **262**, 190 (1891)

25

**HgNO₃****I-1680**

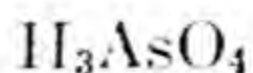
A white precipitate of mercurous pyroarsenate which changes to purplish red is formed when a solution of arsenic acid is brought together with mercurous nitrate.



Simon, Pogg. Ann., **41**, 424

Ref., Ann. **262**, 182 (1891)

1

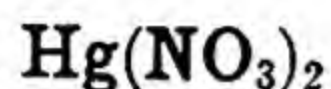
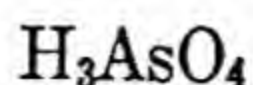
**Hg(NO₃)₂****I-1681**

Mercuric arsenate is formed when an excess of mercuric nitrate is dropped into arsenic acid.



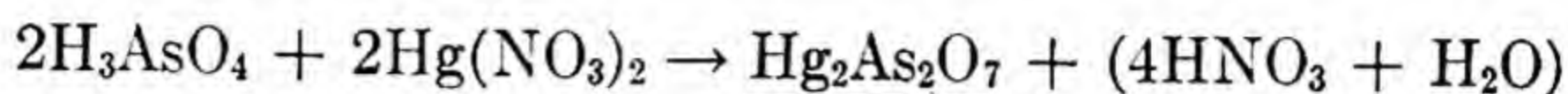
K. Haack: Ann. **262**, 184 (1891)

25



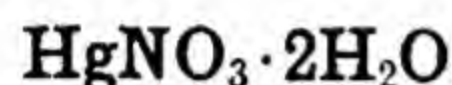
I-1682

A yellow mercuric pyroarsenate is formed when arsenic acid is treated with mercuric nitrate.



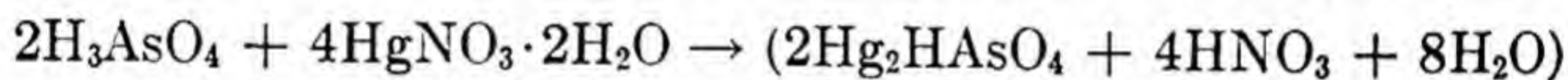
Bergmann, *Opuscula Physica et chemica*, Upsala 1779-1784

10



I-1683

Minute quantities of arsenic may be detected by placing a small drop of the arsenic solution (e.g., arsenic acid) on a glass plate, carefully evaporating it and mixing the residue with a drop of reagent, composed of 10 g. mercurous nitrate, 10 cc. nitric acid (d., 1.39), and 100 cc. distilled water, such that the residue is just covered. After about 2 minutes, the thick macles and crystallites, frequently arranged in double fan form and of brownish yellow hue, as well as almost colorless plates with rounded extremities may be examined under the microscope.



G. Deniges, *Compt. rend.*, **147**, 745 (1908)

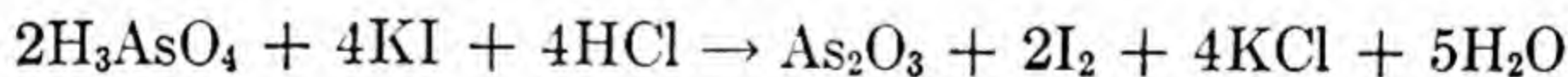
38



I-1684



Arsenic acid may be determined by treating it with potassium iodide in the presence of hydrochloric acid.



Rosenthaler, *Z. Anal. Chem.*, **45**, 596 (1907)

Ref., *J. Am. Chem. Soc.*, **30**, 437 (1908)

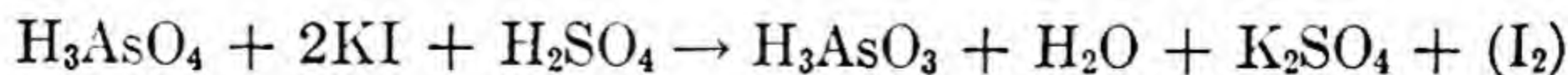
1



I-1685



Arsenic acid is reduced by potassium iodide in the presence of sulfuric acid.

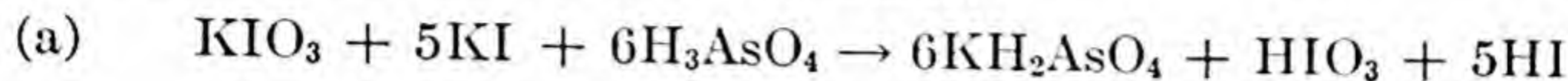


Oberdoerfer and Nieuwland, *J. Am. Chem. Soc.*, **44**, 838 (1922)

1

KIO₃**H₃AsO₄****KI****I-1686**

When a mixture of potassium iodate and potassium iodide is treated with arsenic acid, iodic acid and hydriodic acid are first set free, and then these react to liberate free iodine.

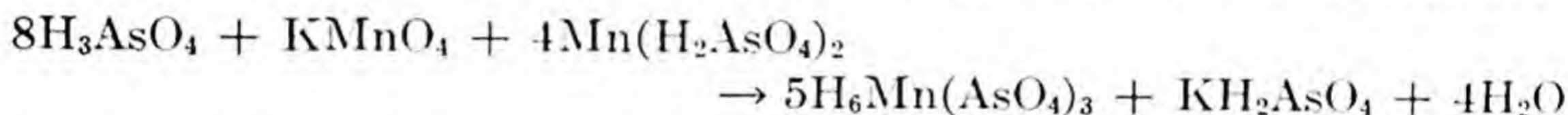


R. Klason and J. Kohler, K. Sv. Vet. Akad. Handl. Bihang., II, **28**, No. 4, 8 (1902)

10

H₃AsO₄**KMnO₄****I-1687****Mn(H₂AsO₄)₂**

A dark violet red colored solution of triarsenic manganic acid is obtained when solutions containing potassium permanganate, manganese hydrogen arsenate and arsenic acid are poured together at room temperature.



Deiss, Z. anorg. Chem., **145**, 371 (1925)

25

H₃AsO₄**KOH****I-1688**

Titration of arsenic acid with potassium hydroxide gives water and a monopotassium dihydrogen or a dipotassium monohydrogen arsenate according as methyl orange or phenolphthalein is used.

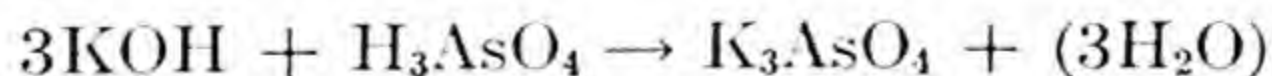


P. Klason and J. Köhler, K. Sv. Kem. Tidskr., **14**, 183 (1902)

10

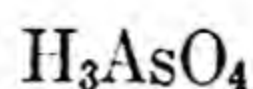
H₃AsO₄**KOH****I-1689**

Potassium hydroxide in excess added to a solution of orthoarsenic acid gives tripotassium arsenate.



Thomas Graham, Trans. Roy. Soc. (London), **123**, 263 (1833)

105

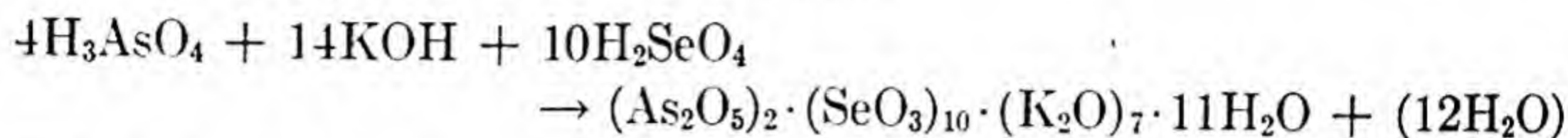


KOH

I-1690

H₂SeO₄

Potassium pentaseleno diarsenate is obtained if a mixture containing a concentrated solution of selenic acid, arsenic acid and potassium hydroxide is evaporated over sulfuric acid.



Weinland and Barttlingek, Ber., **36**, 1397 (1903)

25

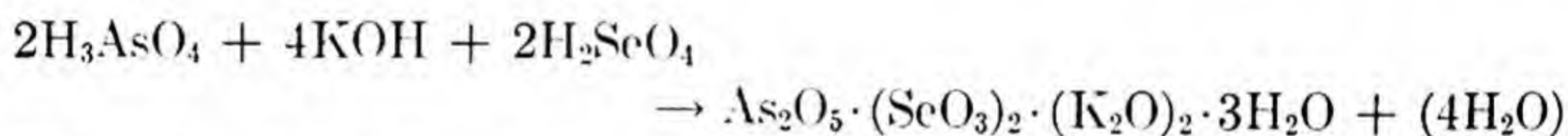


KOH

I-1691

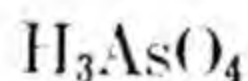
H₂SeO₄

Potassium seleno-monoarsenate is obtained if a solution of selenic acid, potassium hydroxide and arsenic acid is concentrated on the water bath and allowed to cool.



Weinland and Barttlingek, Ber., **36**, 1397 (1903)

25

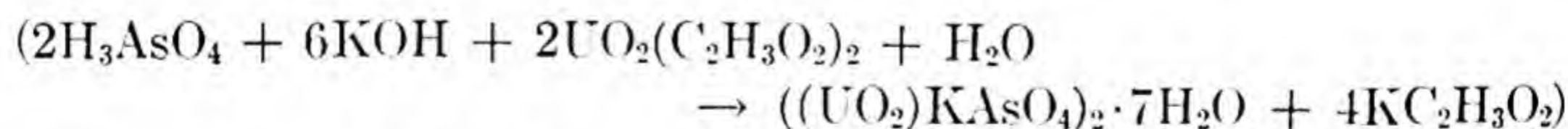


KOH

I-1692

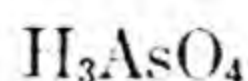
UO₂(C₂H₃O₂)₂

Uranyl potassium arsenate is obtained when arsenic acid is saturated with potassium hydroxide, then made acid with acetic acid and finally mixed with uranyl acetate solution.



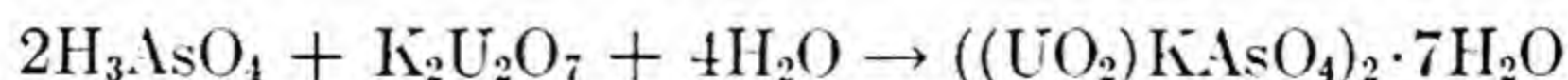
Rimbach: Ber. **37**, 461 (1904)

25

K₂U₂O₇

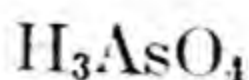
I-1693

Uranyl potassium arsenate can be prepared by long digestion of potassium diuranate with arsenic acid.

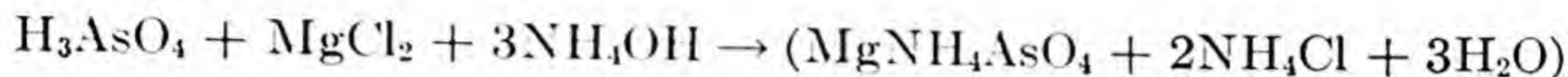


Rimbach: Ber. **37**, 461, (1904)

25

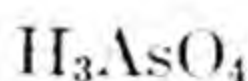
MgCl₂ + NH₄OH**I-1694**

The well-known characteristic reaction of arsenic (e.g., as arsenic acid) with ammoniacal magnesium chloride solutions may be successfully used for identifying minute quantities of arsenic by placing a drop of the unknown on a glass plate, carefully evaporating it and then treating it with a drop of the reagent, examining the crystalline precipitate under a microscope.

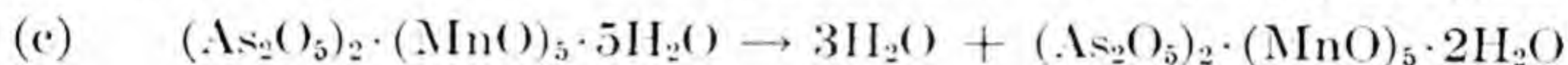
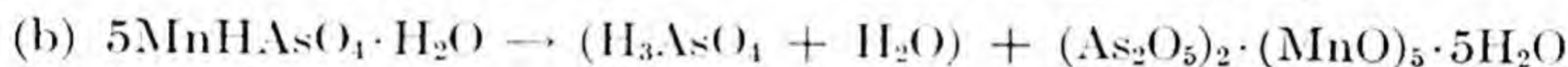
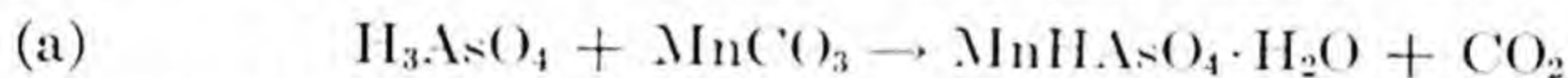


G. Deniges, *Compt. rend.*, **147**, 596 (1908)

38

**MnCO₃****I-1695**

Prismatic crystals are obtained when arsenic acid is treated with manganous carbonate, filtered and boiled with water at 150°.



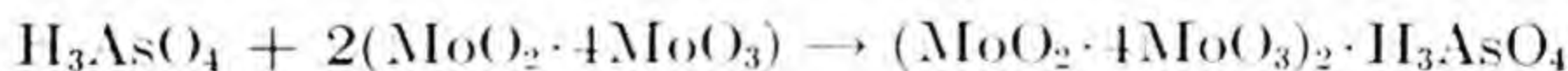
Coloriano, *Compt. rend.*, **103**, 273

Ref., *Ber.*, **19**, 660 (1886)

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**MoO₂ · 4MoO₃****I-1696**

A stable blue salt of arsenic and molybdenum may be formed by addition of molybdenum blue reagent to arsenic acid.

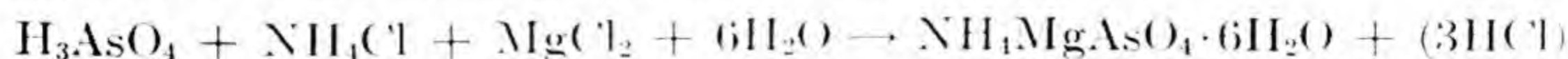


Zinzode, *Ind. Eng. Chem., Anal. Ed.*, **7**, 227 (1935)

33

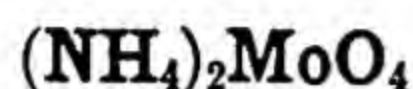
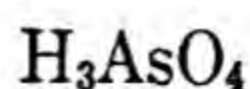
**NH₄Cl****I-1697****MgCl₂**

Orthoarsenic acid reacts with ammonium chloride and magnesium chloride to form ammonium magnesium arsenate.



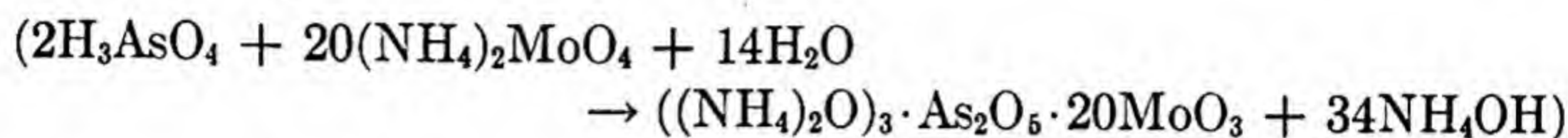
William Gregor, *Trans. Roy. Soc. (London)*, **99**, 204 (1809)

105



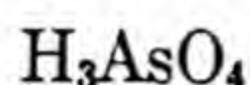
I-1698

When a mixture of arsenic acid, ammonium molybdate and an ammonium salt is heated, an ammonium molybdoarsenate is obtained as a yellow precipitate.



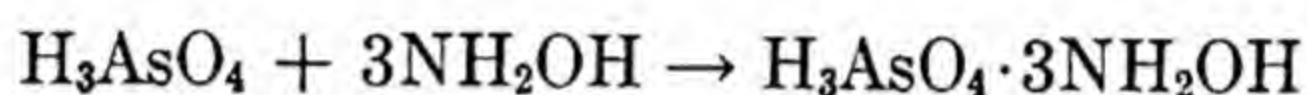
H. Debray, *Compt. Rend.*, **78**, 1409 (1874)

29



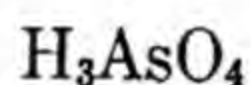
I-1699

Feather-like crystals are formed when a solution of arsenic acid is treated with sodium carbonate and then made barely basic with hydroxylamine.

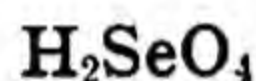


V. Kohlschutter and K. Hofmann: *Ann.* **307**, 329 (1899)

25



I-1700

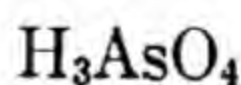


Ammonium seleno-monoarsenate is obtained if a solution of selenic acid, arsenic acid and ammonium hydroxide is concentrated on the water bath and allowed to cool.

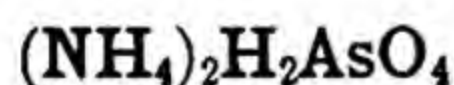


Weinland and Barttlingek, *Ber.*, **36**, 1397 (1903)

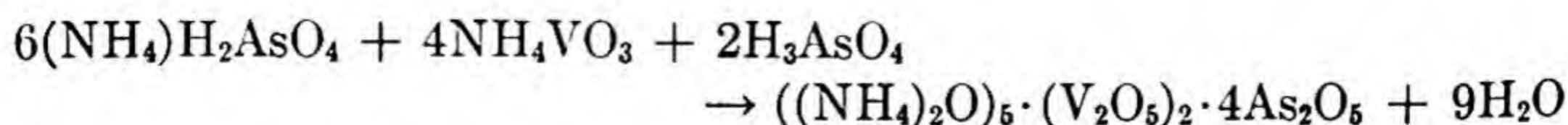
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I-1701



A double compound is formed when vanadium pentoxide, neutralized with ammonium hydroxide, is allowed to react with ammonium dihydrogen arsenate and arsenic acid.

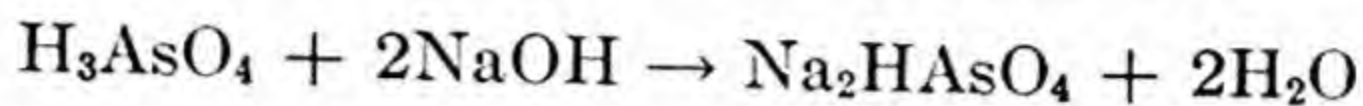


C. Friedheim, *Ber.*, **23**, 2600 (1890)

25

**NaOH****I-1702**

Small amounts of arsenic acid (less than 0.07 g. as arsenic acid or arsenic trioxide) can be quantitatively neutralized with standard sodium hydroxide solution using phenolphthalein as indicator.

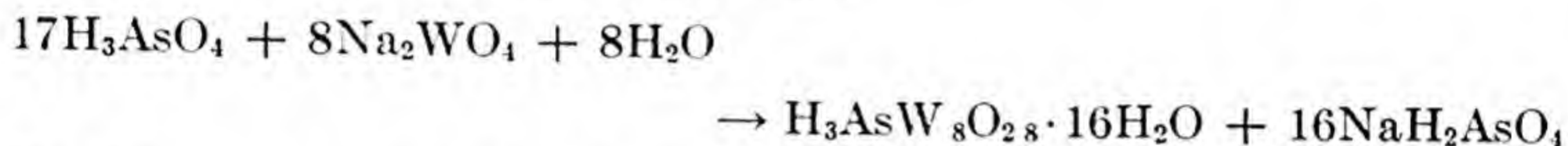


Wiley, Bewley and Irey, *Ind. Eng. Chem., Anal. Ed.*, **4**, 396 (1932)

33

**Na₂WO₄****I-1703**

Anhydroarsenic tungstic acid is formed when sodium tungstate is boiled with an excess of arsenic acid.

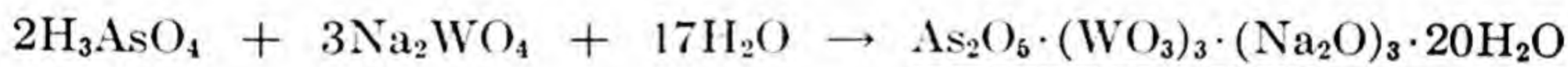


Fr. Kehrman, *Ann.*, **245**, 45-57 (1888)

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**Na₂WO₄****I-1704**

A white precipitate is formed when a very concentrated cold solution of one part of arsenic acid reacts with four parts of cold sodium tungstate solution.



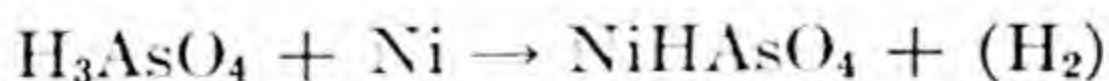
J. Lefort, *Compt. rend.*, **92**, 1461

Ref., *Ber.*, **14**, 2059 (1881)

25

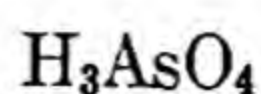
**Ni****I-1705**

Bright green, clinorhombic crystals of nickel hydrogen arsenate are formed when arsenic acid reacts with nickel at 160°.



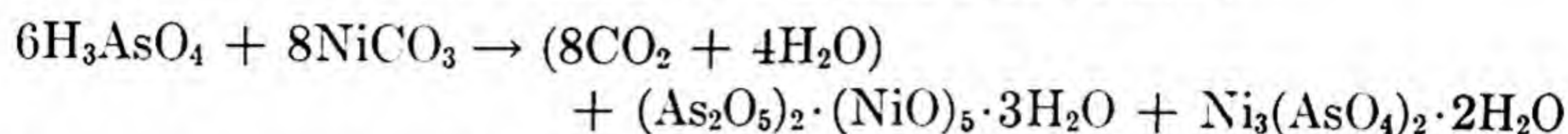
Coloriano, *Compt. rend.*, **103**, 273

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I-1706

Straw-yellow needles and hexagonal apple-green leaflets are formed when nickel carbonate reacts with arsenic acid at 235°.



Coloriano, Compt. rend., **103**, 273

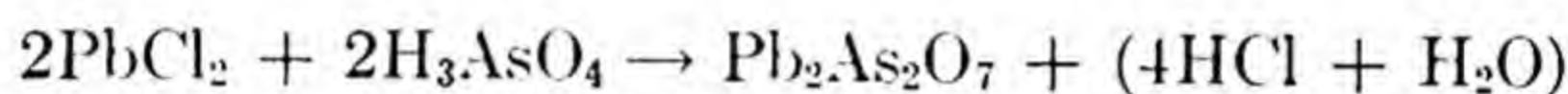
Ref., Ber., **19**, 660 (1886)

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I-1707

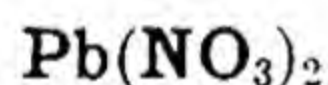
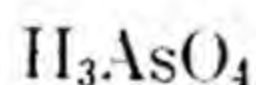
Lead pyroarsenate is precipitated when arsenic acid reacts with lead chloride.



Mitscherlich and Berzelius, Dammer, "Handbuch der anorganischen Chemie", Vol. 2 Pt 2 P. 565

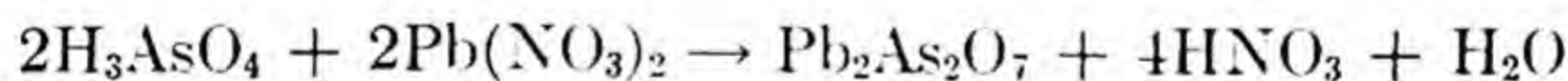
Ref., Tartar and Robinson, J. Am. Soc., **36**, 1844 (1914)

1



I-1708

Lead pyroarsenate is precipitated when lead nitrate reacts with arsenic acid in aqueous solution.



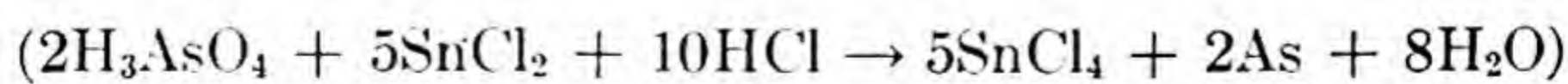
Tartar and Robinson, J. Am. Chem. Soc., **36**, 1844 (1914)

1



I-1709

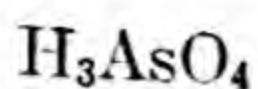
The reduction of arsenic acid in hydrochloric acid solution to brown arsenic by stannous chloride is strongly catalyzed by mercuric mercury. The addition of the latter in a concentration of 10^{-5} mole hastens the reaction.



King and Brown, Ind. Eng. Chem., Anal. Ed., **5**, 168 (1933)

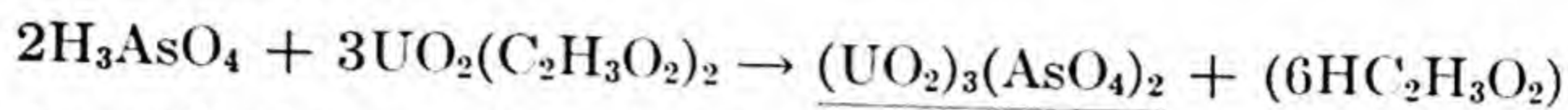
Ref., Kolthoff and Livingston, Ind. Eng. Chem., Anal. Ed., **7**, 212-3 (1935)

33



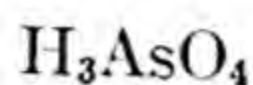
I-1710

Uranyl arsenate is precipitated when uranyl acetate is added to a solution of arsenic acid.



Hilpert and Dieckmann: Ber. **44**, 2385 (1911)

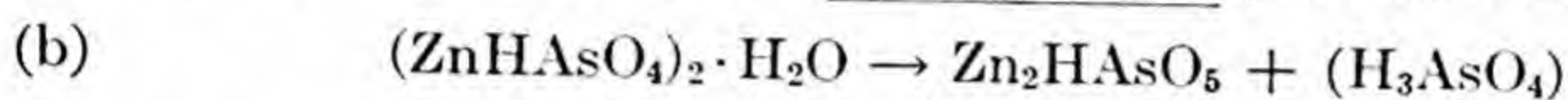
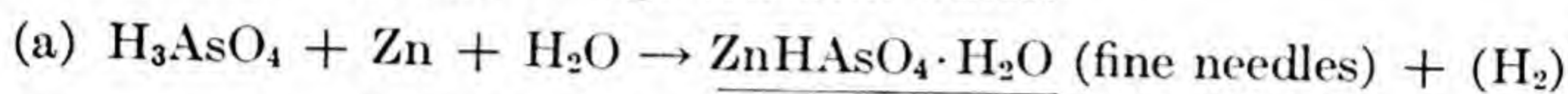
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Zn

I-1711

Adamine is the final product obtained when the reaction product of arsenic acid and zinc is digested with water.



Coloriano, Compt. rend. **103**, 273

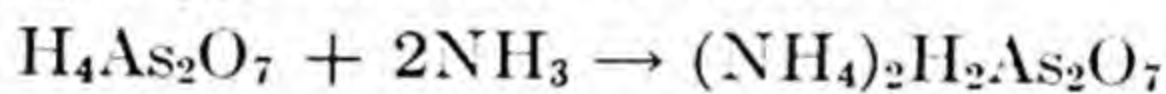
Ref., Ber., **19**, 660 (1886) abstr.

25

 NH_3

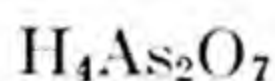
I-1712

By heating pyroarsenic acid to 50° in an atmosphere of ammonia, diammonium hydrogen pyroarsenate is formed.



A. Rosenheim and H. Antelmann, Z. anorg. Chem., **187**, 385 (1930)

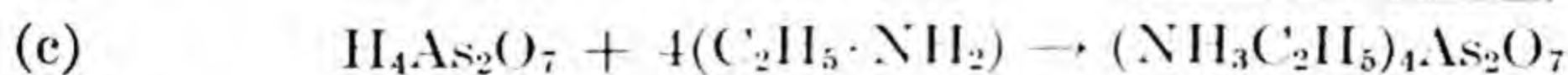
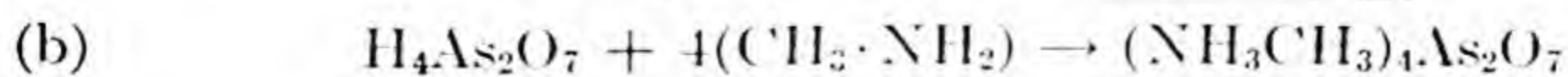
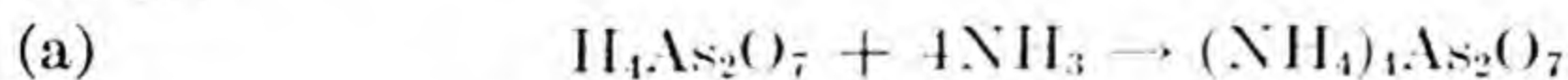
28

 NH_3

I-1713

 $\text{CH}_3 \cdot \text{NH}_2$ $\text{C}_2\text{H}_5 \cdot \text{NH}_2$

Pyroarsenic acid in powder form is put into a glass tube. Dry, liquid ammonia is added. The sealed tube is left for 24 hours under shaking at room temperature. Crystals of ammonium pyroarsenate are obtained. The same type reaction occurs with methyl amine and ethyl amine.

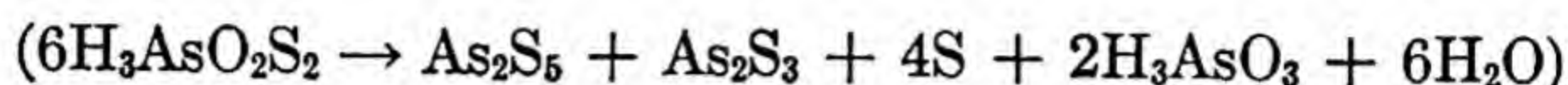


A. Rosenheim and H. Antelmann, Z. anorg. Chem., **187**, 385 (1930)

28

**Decomp.****I-1714**

Dithioarsenic acid decomposes into arsenic pentasulfide and arsenious acid when kept in a closed flask for 24–36 hours in the presence of hydrochloric acid.

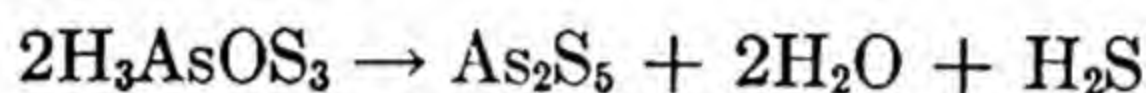


McCay and Foster: *Z. anorg. Chem.* **41**, 452 (1904)

28

**(HCl)****I-1715**

Trithioarsenic acid decomposes into arsenic pentasulfide, hydrogen sulfide and water when kept in a closed flask for 24–36 hours in the presence of hydrochloric acid.

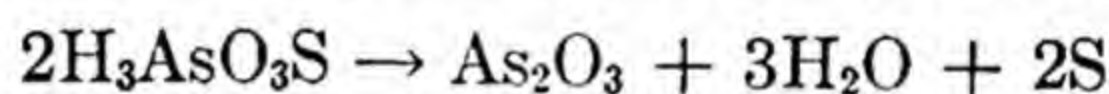


McCay and Foster: *Z. anorg. Chem.* **41**, 452 (1904)

28

**Decomp.****I-1716**

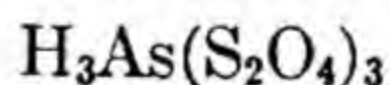
Monothioarsenic acid decomposes into arsenic trioxide and sulfur.



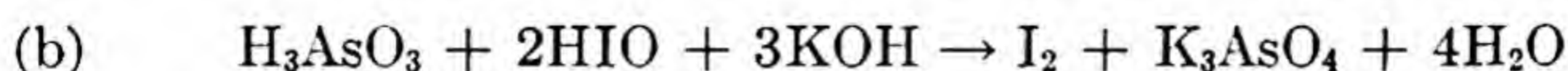
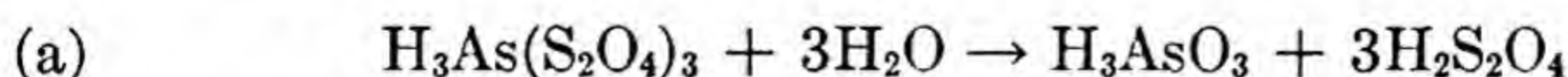
Brauner, *J. Chem. Soc.*, (London), **67**, 527 (1895)

Ref., Weinland Rumpf, *Z. anorg. Chem.*, **14**, 42 (1897)

48

**HIO****I-1717****KOH**

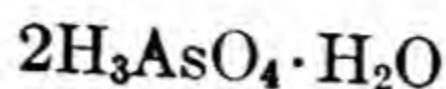
Free iodine is liberated along with the formation of potassium arsenate when arsenodithionous acid hydrolyzes in the presence of hypoiodous acid and potassium hydroxide.



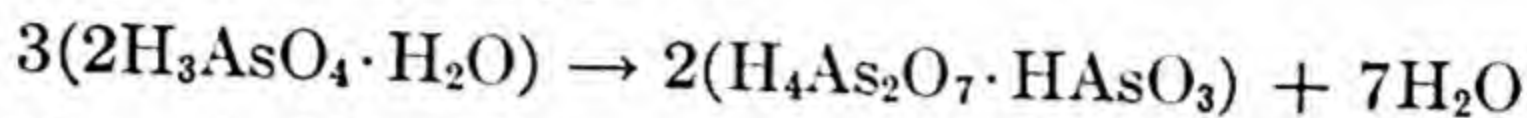
Wilke, *J. Soc. Chem. Ind.*, **42**, 356T (1923)

Ref., *J. Chem. Soc.* (London), (1927), 2020

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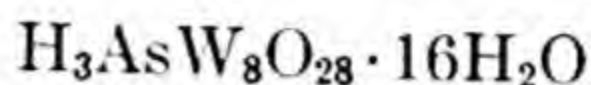
**Dehydr.****I-1718**

Dehydration of the hydrate of orthoarsenic acid at low temperature over sulfuric acid forms pyroarsenic metarsenic acids and not the hydrate $\text{H}_6\text{As}_4\text{O}_{13}$, as previously supposed.

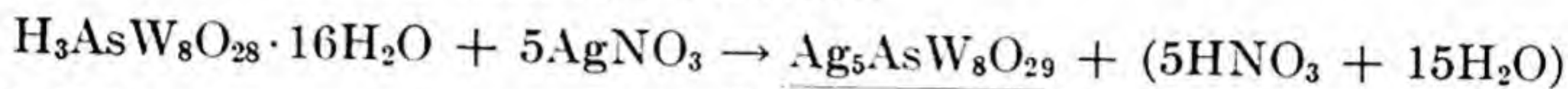


Auger, Compt. rend., **146**, 588 (1908)

38

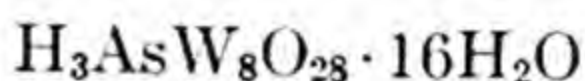
**AgNO₃****I-1719**

An insoluble white silver salt is obtained when *d*-anhydro-arsenic tungstic acid is treated with silver nitrate.

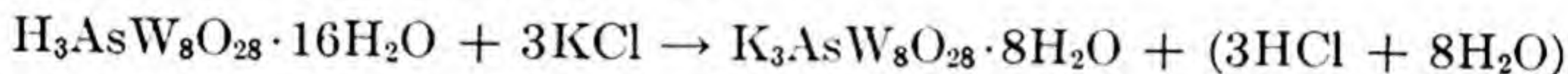


F. Kehrman, Ber., **21**, 467 (1888)

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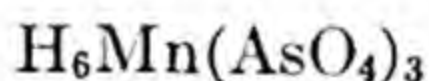
**KCl****I-1720**

The potassium salt is formed when *d*-anhydroarsenic tungstic acid is treated with potassium chloride.



F. Kehrman, Ber., **21**, 467 (1888)

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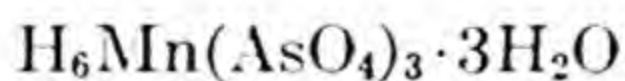
**H₂O****I-1721**

Manganic arsenate is produced when manganic hexahydrogen arsenate is treated with water.

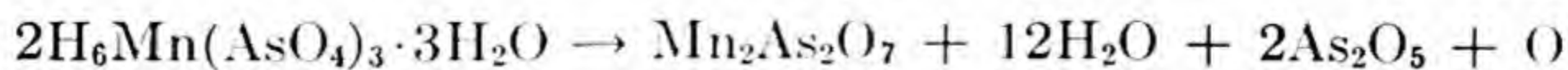


E. Deiss, Z. anorg. Chem., **145**, 375 (1925)

28

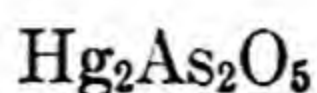
**Δ****I-1722**

By heating the crystals of manganic hexahydrogen arsenic acid over the flame of a Bunsen burner dimanganese pyroarsenate is obtained.

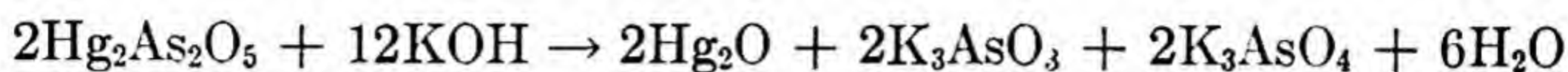


E. Deiss, Z. anorg. Chem., **145**, 365 (1925)

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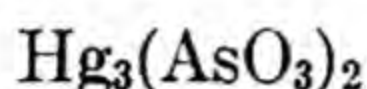
**KOH****I-1723**

Mercurous oxide is formed when mercuric pyroarsenite is treated with a solution of potassium hydroxide.

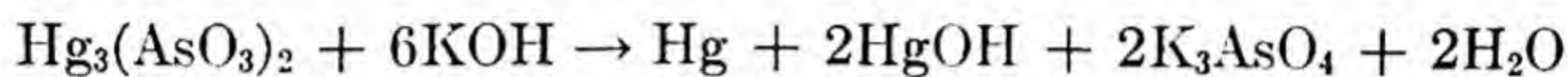


Reichard: Ber., **27**, 1016 (1894)

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**KOH****I-1724**

A solution of mercuric orthoarsenite in potassium hydroxide undergoes decomposition as shown below.

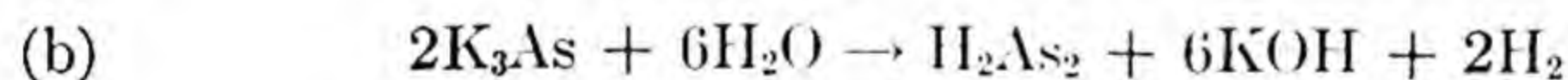


A. Raynoso, Compt. Rend., **31**, 69 (1850)

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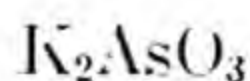
**H₂O****I-1725**

Potassium arsenide will react with water yielding arsine, solid arsenic hydride and metallic arsenic. At higher temperatures the arsine and arsenic hydride formed are decomposed to metallic arsenic and hydrogen. Similar reactions take place with sodium arsenide.

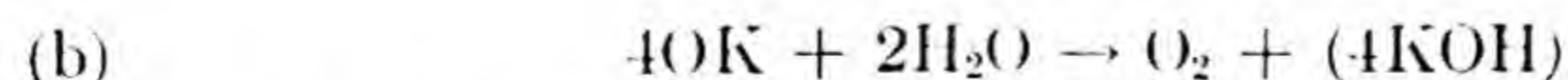
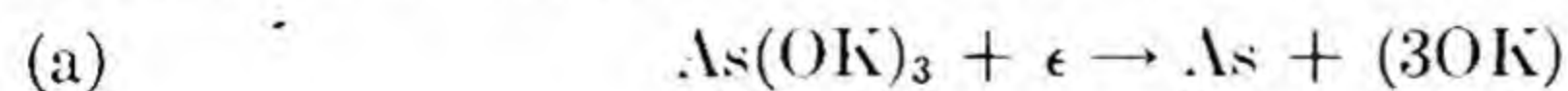


H. Reckleben and J. Scheiber, Z. anorg. Chem., **70**, 255 (1911)

28

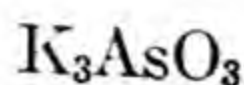
**ε****I-1726**

A solution of potassium arsenite when electrolyzed deposited metallic arsenic at the cathode and gave off oxygen at the anode.



J. Frederic Daniell and W. A. Miller, Trans. Roy. Soc. (London), **134**, 6 (1844)

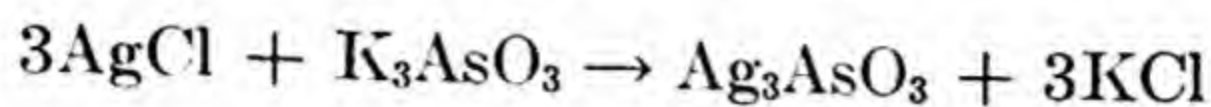
105



AgCl

I-1727

Although silver chloride is insoluble in potassium hydroxide it dissolves readily if some potassium arsenite is added.



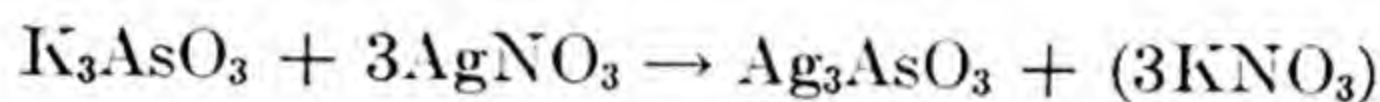
A. Reynoso, *Compt. Rend.*, **31**, 69 (1850)

29

AgNO₃

I-1728

When silver nitrate was added to a solution of potassium arsenite yellow silver arsenite was precipitated.



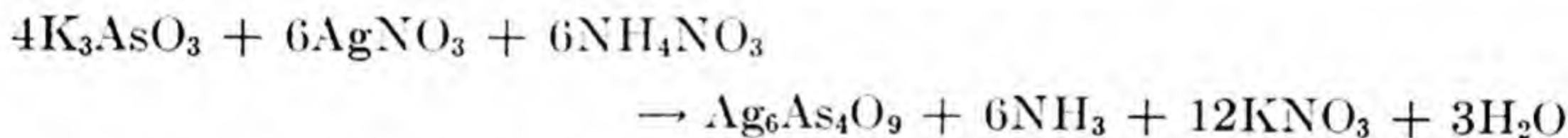
J. Frederic Daniell and W. A. Miller, *Trans. Roy. Soc. (London)* **134**, 6 (1844)

105

AgNO₃

I-1729

Upon the addition of potassium arsenite drop by drop to silver nitrate in a large excess of ammonium nitrate, a white precipitate of silver tetrarsenite is formed, with evolution of ammonia.



Girard, *Compt. Rend.*, **34**, 920 (1852)

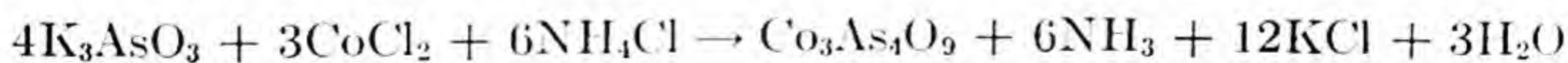
29

CoCl₂

I-1730

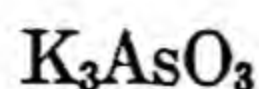
NH₄Cl

When potassium arsenite is poured into a solution of cobalt chloride dissolved in a large excess of ammonium chloride, ammonia is given off, and an amethyst precipitate of cobalt tetrarsenite is formed.



Girard, *Compt. Rend.*, **34**, 919 (1852)

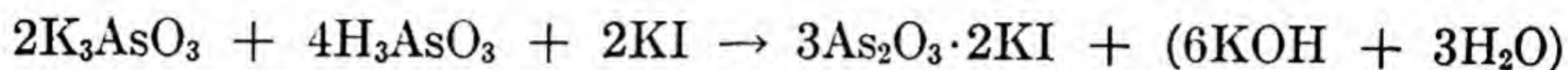
29



I-1731

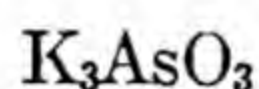


A white crystalline double salt is formed when potassium arsenite exactly neutralized with dilute arsenious acid is treated with potassium iodide.



J. Emmet: Sillim. J. Ser. K, **18**, 58 (1830)

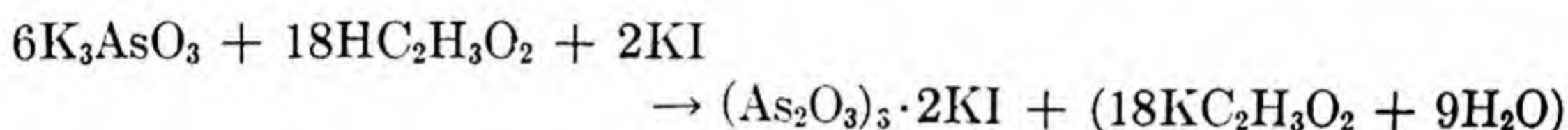
25



I-1732



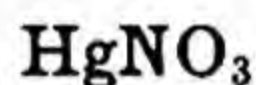
A double salt in the form of a white crystalline powder is made when potassium arsenite exactly neutralized with dilute acetic acid is treated with potassium iodide.



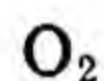
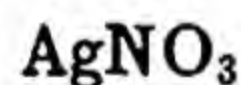
J. Emmet: Sillim. J. Ser. I, **18**, 58 (1830)

Ref., Ann., **228**, 72 (1885)

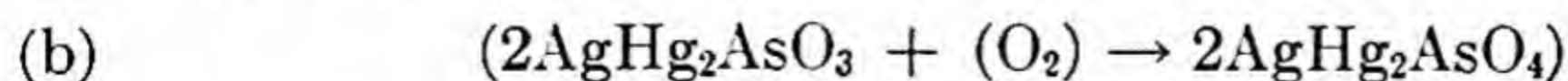
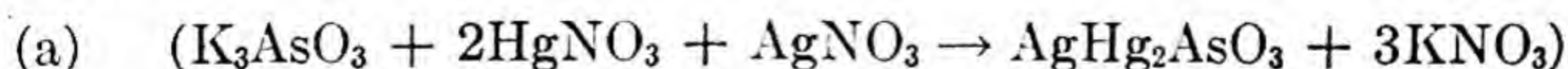
25



I-1733



Solid HgNO_3 is slowly dissolved in water and acidified with nitric acid. Silver nitrate is added to this and the solution is diluted, again acidified with nitric acid and potassium arsenite is added. This solution is again acidified and oxygen is passed through it at about 50°C . Crystals of silver mercurous arsenate deposit.

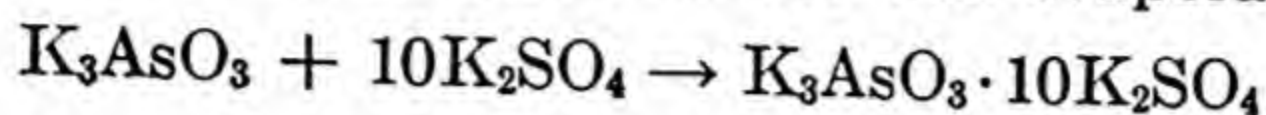


Jules Jacobsen, Bull. Soc. Chim., [4] **5**, 948 (1909)

31

K₂SO₄**K₃AsO₃****I-1734**

Shining hexagonal crystals separated when a solution containing potassium orthoarsenite and potassium sulfate was evaporated.



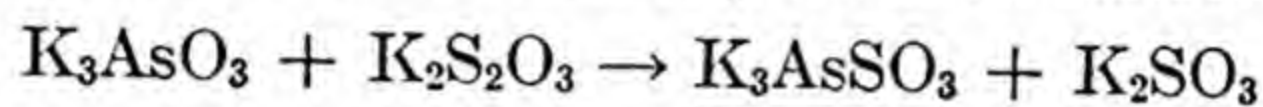
Stavenhagen, *Z. anorg. Chem.*, **165**, (1894)

Ref., *Ber.*, **27**, 335 (1894)

25

K₃AsO₃**K₂S₂O₃****I-1735**

Crystals are formed when a concentrated solution of potassium arsenite reacts with a concentrated solution of potassium thiosulfate.

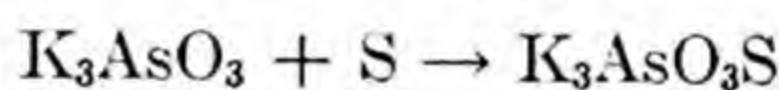


R. F. Weinland and A. Gutmann, *Z. anorg. Chem.*, **17**, 409 (1898)

28

K₃AsO₃**S****I-1736**

An impure potassium monothioarsenate is prepared by boiling precipitated sulfur with a solution of potassium ortho-arsenite and evaporating in a vacuum over concentrated sulfuric acid.

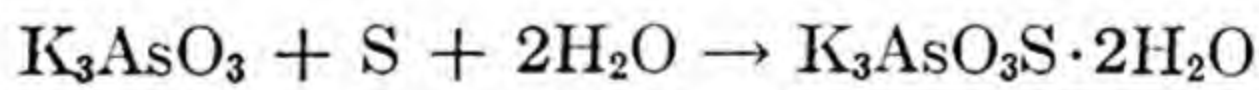


Weinland and Rumpf: *Z. anorg. Chem.*, **14**, 42 (1897)

25

K₃AsO₃**S****I-1737**

White crystals are obtained by heating a solution of potassium ortho-arsenite with sulfur.

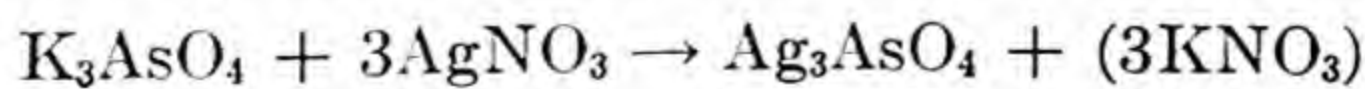


R. F. Weinland and O. Rumpf, *Z. anorg. Chem.*, **14**, 42 (1897)

28

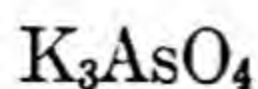
K₃AsO₄**AgNO₃****I-1738**

A solution containing potassium arsenate and excess potassium hydroxide precipitates brick red silver arsenate when silver nitrate is added.

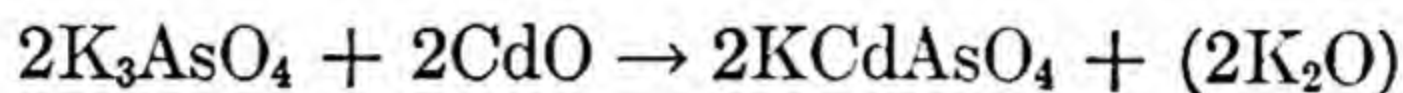


J. Frederic Daniell and W. A. Miller, *Trans. Roy. Soc. (London)*, **134**, 6 (1844)

105

**CdO****I-1739**

Potassium cadmium arsenate forms when cadmium oxide reacts with potassium arsenate.

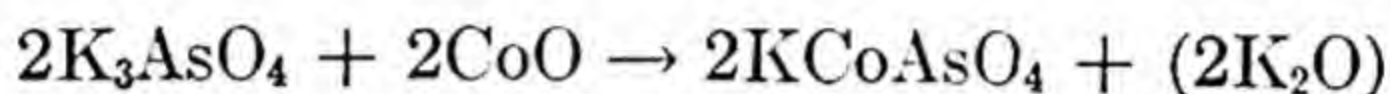


C. Lefevre: *Compt. rend.*, **110**, 405

25

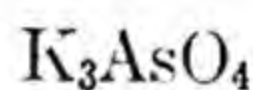
**CoO****I-1740**

Potassium cobalt arsenate is formed when cobaltous oxide reacts with potassium arsenate.

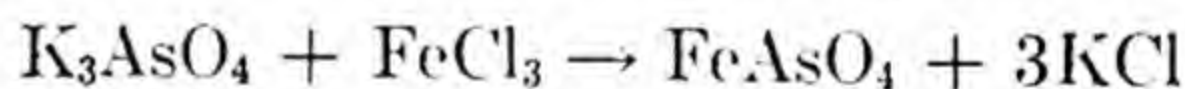


C. Lefevre: *Compt. rend.*, **110**, 405

25

**FeCl₃****I-1741**

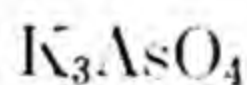
Ferric arsenate is formed when ferric chloride reacts with potassium arsenate in the presence of potassium thio cyanate.



Franceschi: *L'Orosi*, **15**, 192

Ref., Metzke: *Z. anorg. Chem.*, **19**, 457 (1899)

25

**FeCl₃****I-1742**

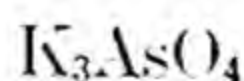
Ferric acid arsenate is formed when ferric chloride reacts with dipotassium acid arsenate in the presence of potassium thiocyanate.



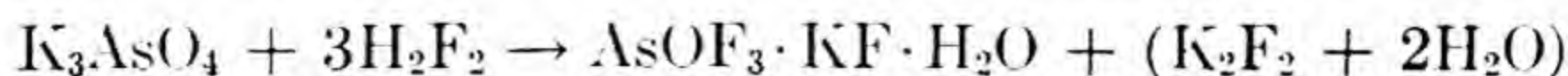
Franceschi, *L'Orosi*, *Boll. chim. farm.*, **15**, 192-195

Ref., Metzke, *Z. anorg. Chem.*, **19**, 457 (1899)

25

**H₂F₂****I-1743**

Pointed rhombic crystals are obtained when potassium arsenate is dissolved in a limited amount of hydrofluoric acid.

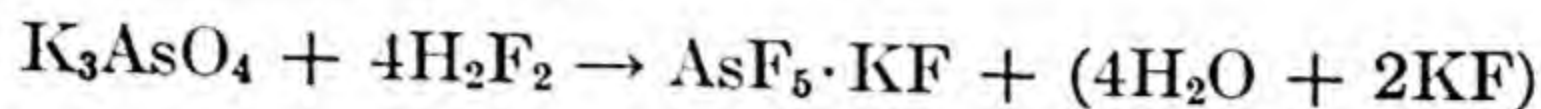


C. Marignac, *Ann.*, **145**, 250 (1868)

25

H₂F₂**K₃AsO₄****I-1744**

Rhombic crystals are obtained when potassium arsenate is dissolved in an excess of hydrofluoric acid.

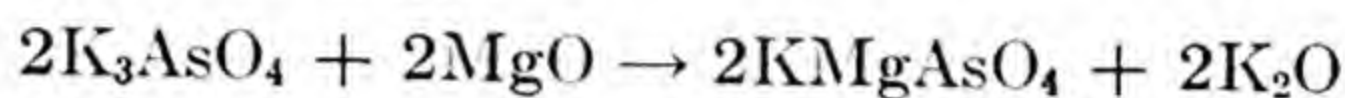


C. Marignac, *Ann.*, **145**, 249 (1868)

1

MgO**K₃AsO₄****I-1745**

Potassium magnesium arsenate originates when magnesium oxide reacts with potassium arsenate.

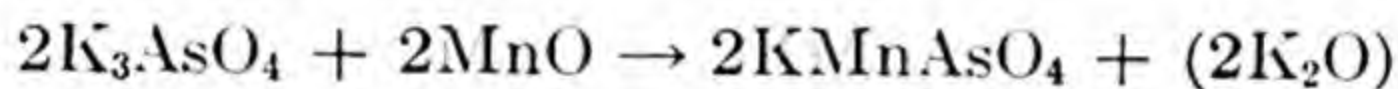


C. Lefevre: *Compt. rend.*, **110**, 405

25

MnO**K₃AsO₄****I-1746**

Potassium manganese arsenate forms when manganous oxide reacts with potassium arsenate.

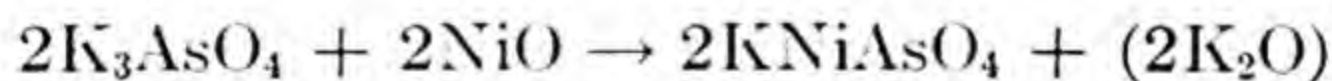


C. Lefevre: *Compt. rend.*, **110**, 405

25

NiO**K₃AsO₄****I-1747**

Potassium nickel arsenate forms when nickel oxide reacts with potassium arsenate.

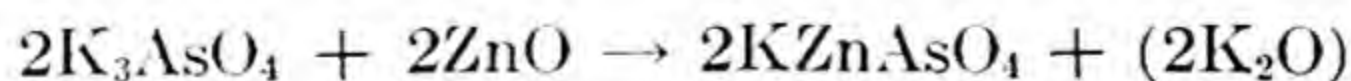


C. Lefevre: *Compt. rend.*, **110**, 405-408

25

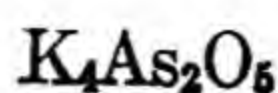
ZnO**K₃AsO₄****I-1748**

Potassium zinc arsenate forms when zinc oxide reacts with potassium arsenate.



C. Lefevre: *Compt. rend.*, **110**, 405

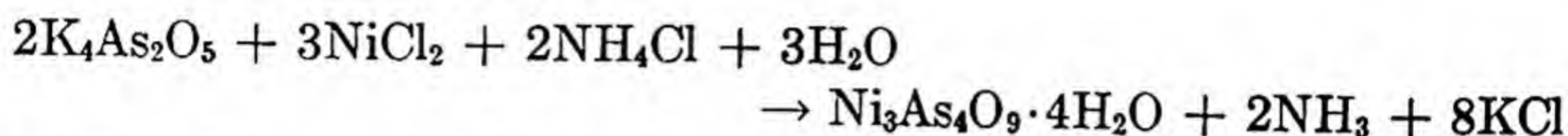
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I-1749

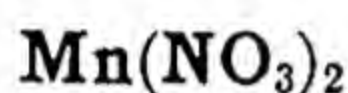
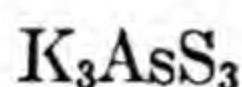


Upon rapidly adding potassium pyroarsenite to a solution of nickel chloride dissolved in a large excess of ammonium chloride, the solution becomes blue at first, giving off ammonia, and then a white precipitate of nickel tetrarsenite is formed.



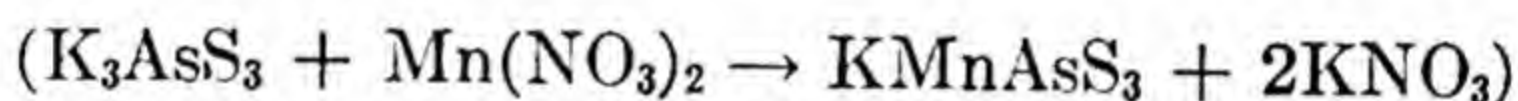
Girard, *Compt. Rend.*, **34**, 919 (1852)

29



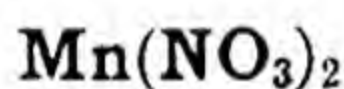
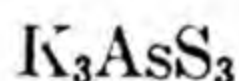
I-1750

A concentrated solution of potassium thioarsenite reacts with manganous salts precipitating a granular, rose colored precipitate of potassium manganous thioarsenite.



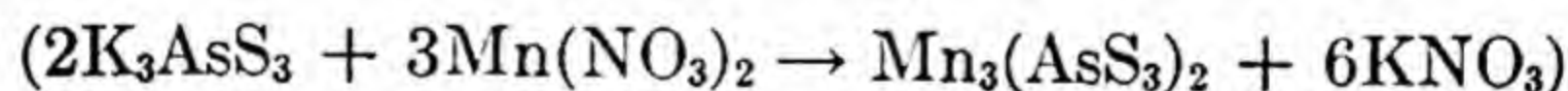
Wunchendorff and Valier, *Bull. Soc. Chim.*, [4], **51**, 1531 (1932)

31



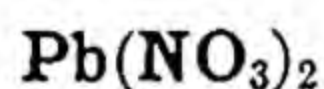
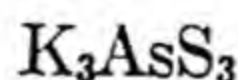
I-1751

A dilute solution of potassium thioarsenite reacts with a solution of manganous nitrate to produce a rose colored amorphous precipitate of manganous thioarsenite which is readily oxidized.



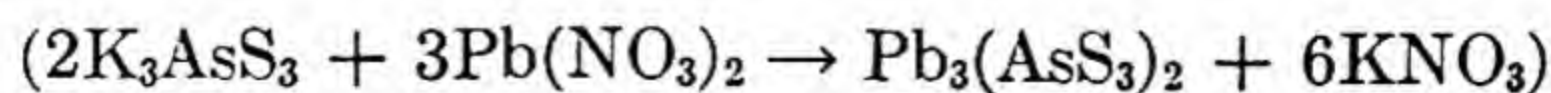
Wunchendorff and Valier, *Bull. Soc. Chim.*, [4], **51**, 1530 (1932)

31



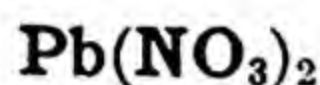
I-1752

When a dilute solution of potassium orthothioarsenite is added to a solution of lead nitrate brown-maroon amorphous lead orthothioarsenite precipitates.



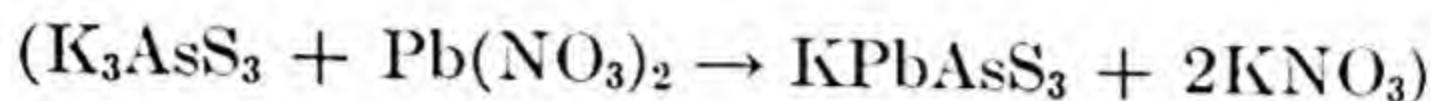
Wunschendorff and Valier, *Bull. Soc. Chim.*, [4], **51**, 1530 (1932)

31



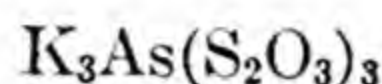
I-1753

If a concentrated solution of potassium orthothioarsenite is added to a solution of lead nitrate yellow-orange prisms of potassium lead thioarsenite form.



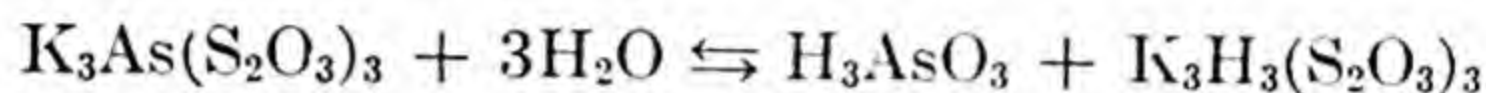
Wunchendorff and Valier, Bull. Soc. Chim., [4], **51**, 1530 (1932)

31



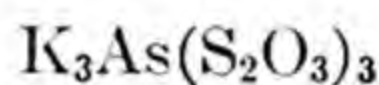
I-1754

Arsenious acid is formed through hydrolysis when tripotassium-arsenic thiosulfate is dissolved in water.



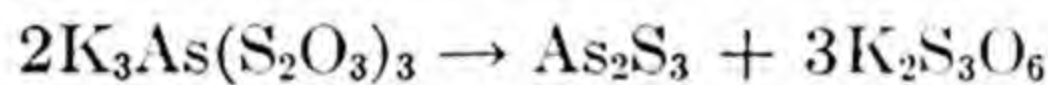
F. Foerster and G. Stühmer, Z. anorg. Chem. **206**, 1 (1932)

28



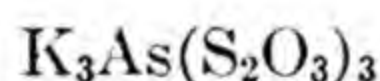
I-1755

By boiling potassium arsenic thiosulfate with water arsenic trisulfide and potassium trithionate are obtained.



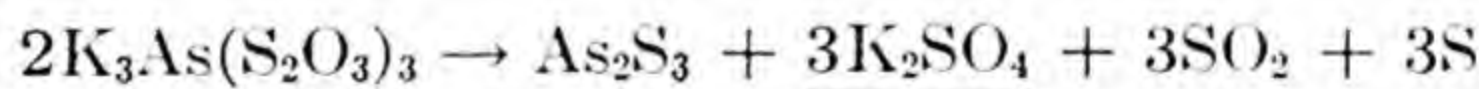
J. v. Szilágyi, Z. anorg. Chem., **113**, 75 (1920)

28



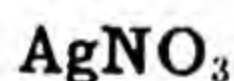
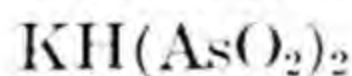
I-1756

Arsenic trisulfide is obtained by the dry distillation of potassium arsenic thiosulfate.



J. v. Szilágyi, Z. anorg. Chem., **113**, 75 (1920)

28



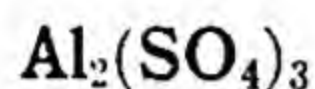
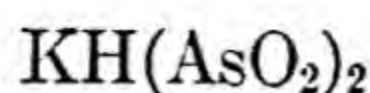
I-1757

A precipitate is formed when silver nitrate is added to a solution of potassium hydrogen metarsenite.



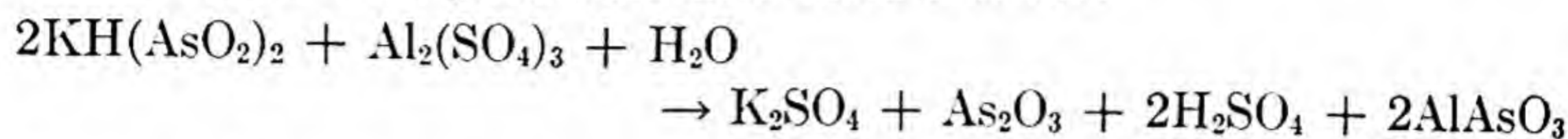
Reichard: Ber., **27**, 1019 (1894)

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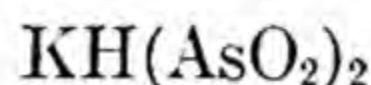
I-1758

An aluminum arsenite forms when a saturated solution of aluminum sulfate reacts with potassium acid meta arsenite.



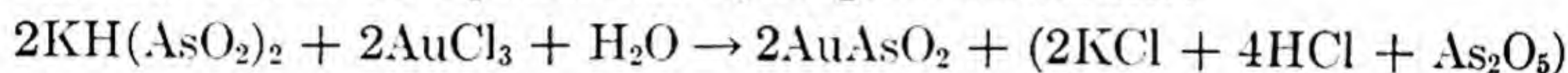
Reichard: Ber., **27**, 1019 (1894)

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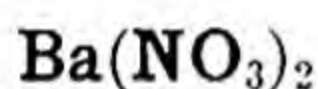
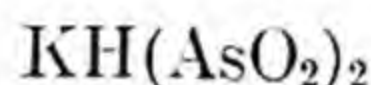
I-1759

A gold arsenite is obtained when a concentrated solution of auric chloride reacts with potassium hydrogen metarsenite.



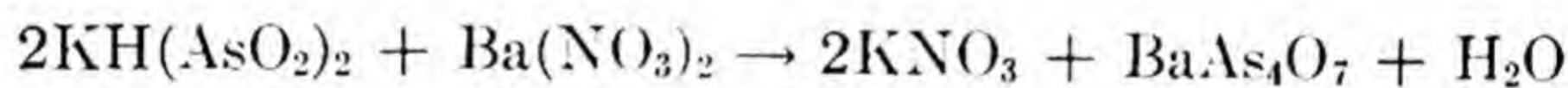
Reichard, Ber., **27**, 1019 (1894)

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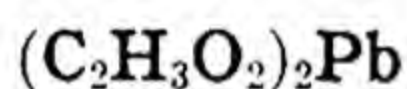
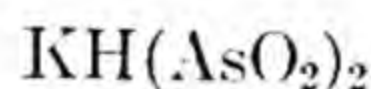
I-1760

A white flocculent precipitate of barium pyroarsenate is obtained when a solution of barium nitrate reacts with potassium hydrogen metarsenite.



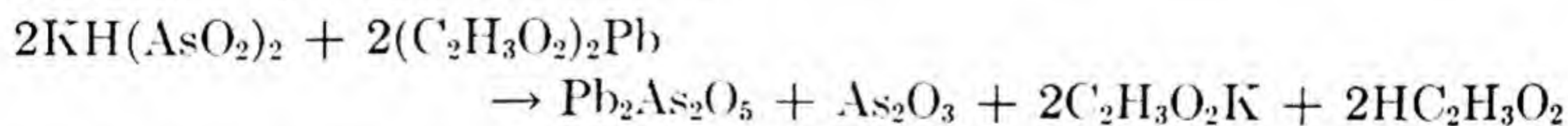
Reichard, Ber., **27**, 1019 (1894)

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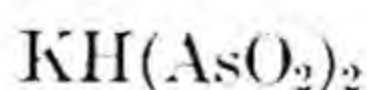
I-1761

A lead arsenite is formed when lead acetate in solution reacts with potassium hydrogen metarsenite.



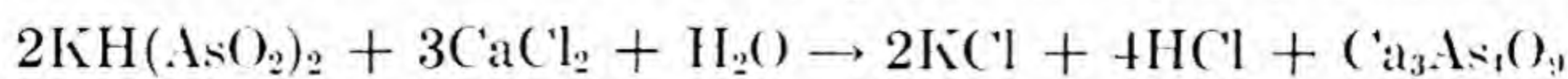
Reichard, Ber., **27**, 1019 (1894)

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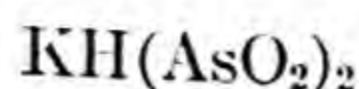
I-1762

A precipitate of calcium tetrarsenite forms when a concentrated solution of calcium chloride reacts with potassium hydrogen metarsenite.



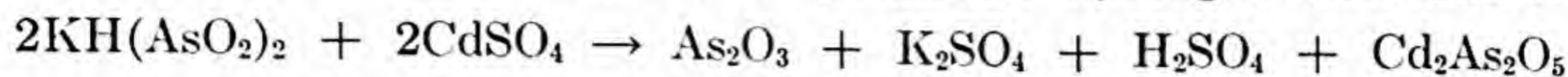
Reichard, Ber., **27**, 1019 (1894)

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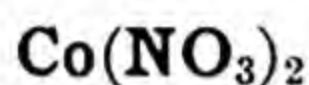
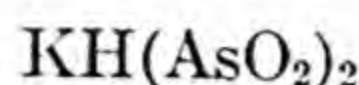
I-1763

A white, slimy precipitate of cadmium diarsenite forms when cadmium sulfate reacts with a solution of potassium hydrogen metarsenite.



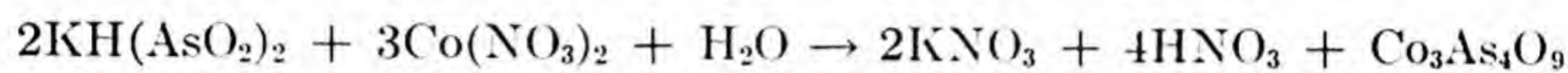
Reichard, Ber., **27**, 1019 (1894)

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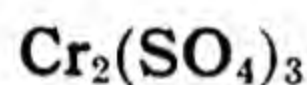
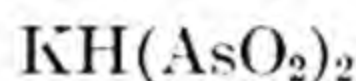
I-1764

A precipitate, cobalt tetrarsenite, is formed when a solution of cobaltous nitrate reacts with a solution of potassium hydrogen metarsenite.



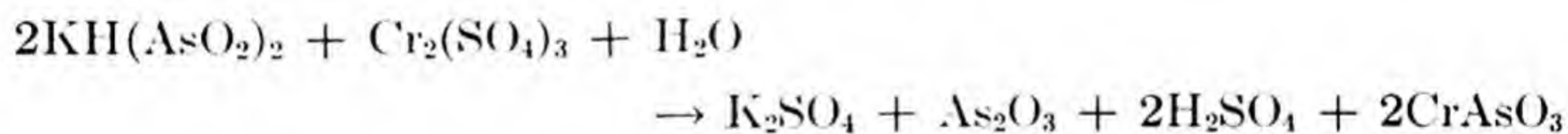
Reichard, Ber., **27**, 1019 (1894)

25



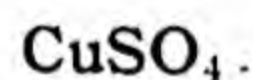
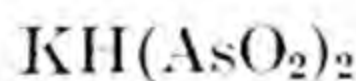
I-1765

A dark green precipitate of chromic arsenite forms when a concentrated solution of chromic sulfate is heated to 100° with a concentrated solution of potassium hydrogen metarsenite.

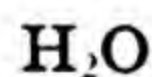


Reichard, Ber., **27**, 1019 (1894)

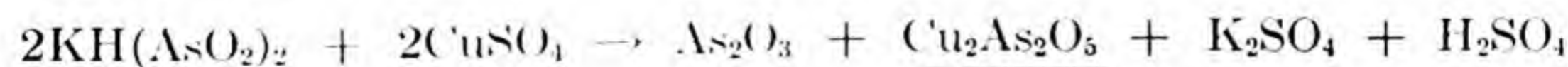
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I-1766



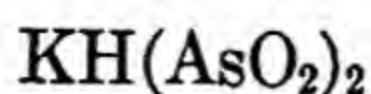
A bright green amorphous copper pyroarsenite is obtained when a dilute copper sulfate solution is precipitated with potassium hydrogen metarsenite.



Bloxam, J. Chem. Soc., (London), **15**, 281

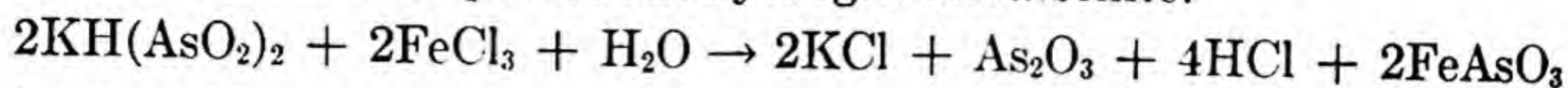
Ref., Reichard, Ber., **27**, 1019 (1894)

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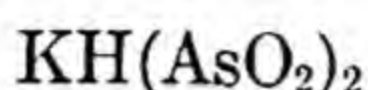
I-1767

A yellow precipitate of ferric arsenite is formed when a solution of ferric chloride reacts with potassium hydrogen metarsenite.



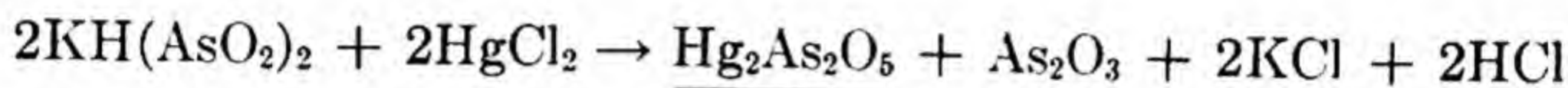
Reichard, Ber., 27, 1019 (1894)

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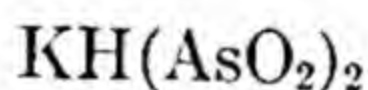
I-1768

A yellowish white mercury diarsenite is obtained when a dilute solution of mercuric chloride is treated with potassium hydrogen metarsenite.



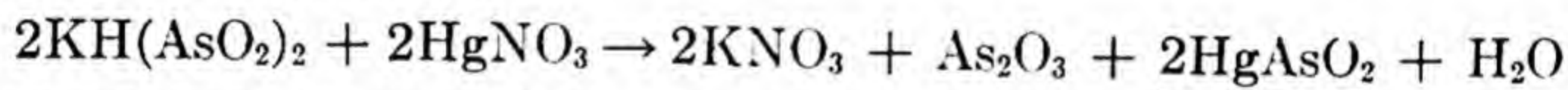
Reichard, Ber., 27, 1019 (1894)

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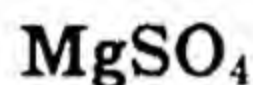
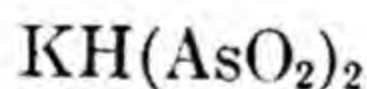
I-1769

A yellowish precipitate of a mercurous metarsenite is obtained when mercurous nitrate solution is added dropwise to a solution of potassium hydrogen metarsenite.



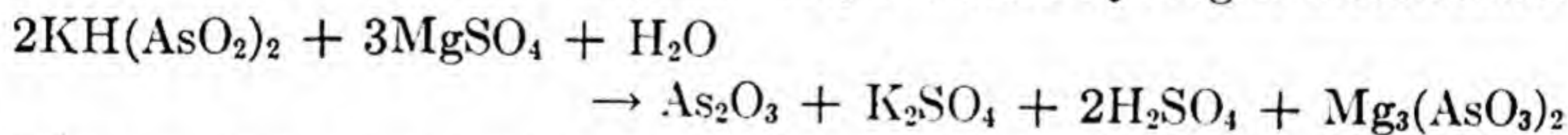
Reichard, Ber., 27, 1019 (1894)

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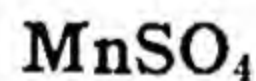
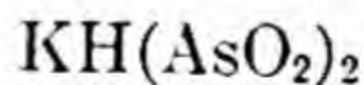
I-1770

A magnesium arsenite is formed when a concentrated solution of magnesium sulfate is added dropwise to potassium hydrogen metarsenite.



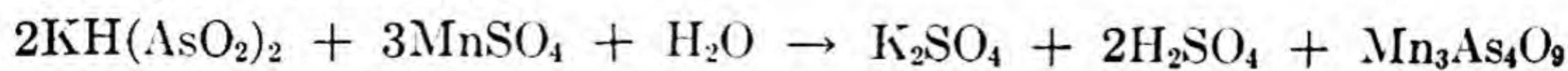
Reichard, Ber., 27, 1019 (1894)

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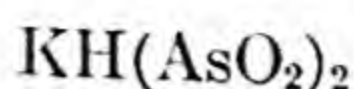
I-1771

A snow-white curdy precipitate of manganese tetrarsenite is formed when a dilute solution of manganous sulfate reacts with potassium hydrogen metarsenite.



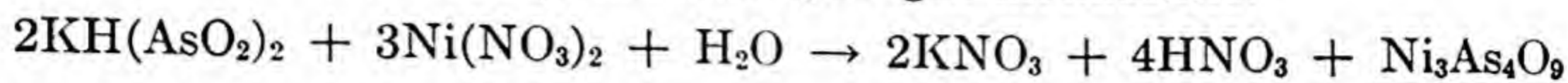
Reichard, Ber., 27, 1019 (1894)

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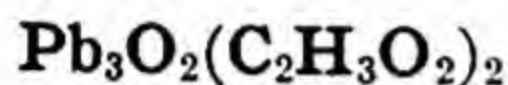
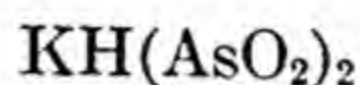
I-1772

A bright green precipitate of nickel tetrarsenite is formed when nickel nitrate is treated with potassium hydrogen metarsenite.



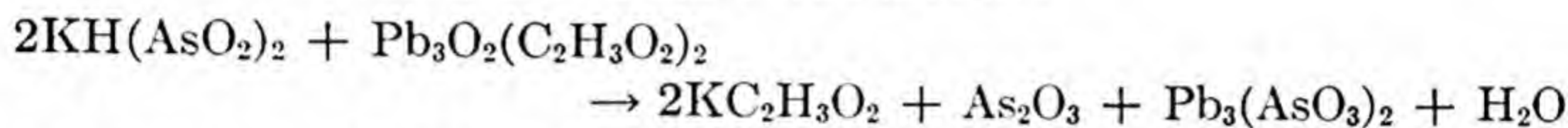
Reichard, Ber., 27, 1019 (1894)

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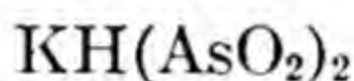
I-1773

Lead arsenite is formed when potassium hydrogen metarsenite is treated with a solution of a basic lead acetate.



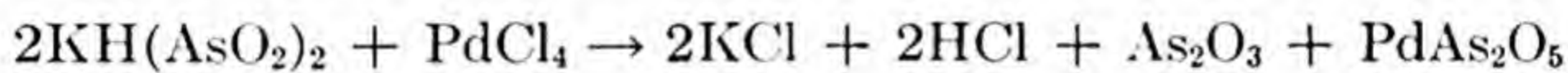
Reichard, Ber., 27, 1019 (1894)

25



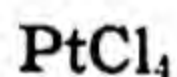
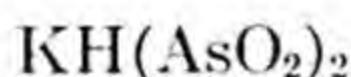
I-1774

A bright yellow flocculent precipitate of palladium diarsenite is formed when a slightly acidified solution of palladium chloride reacts with potassium hydrogen metarsenite.



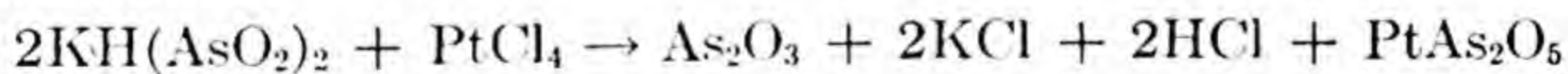
Reichard, Ber., 27, 1019 (1894)

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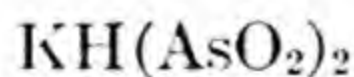
I-1775

A bright yellow heavy precipitate of platinum diarsenite is formed when a solution of platinum tetrachloride reacts with potassium hydrogen metarsenite.



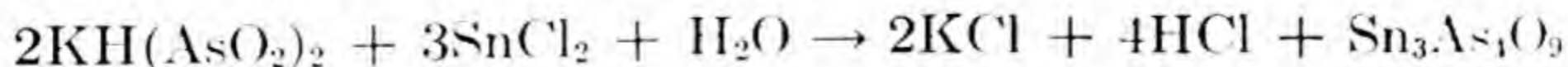
Reichard, Ber., 27, 1019 (1894)

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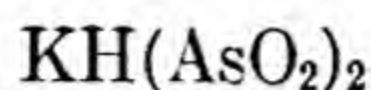
I-1776

A white curdy precipitate of tin tetrarsenite is obtained when a solution of stannous chloride reacts with potassium hydrogen metarsenite.



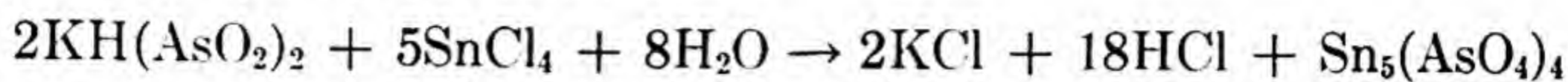
Reichard, Ber., 27, 1019 (1894)

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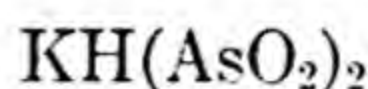
I-1777

A tin arsenate is formed when stannic chloride reacts with a solution of potassium hydrogen metarsenite.



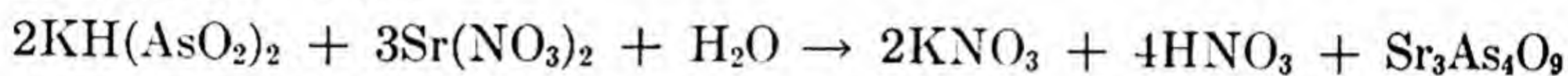
Reichard, Ber., **27**, 19 (1894)

25



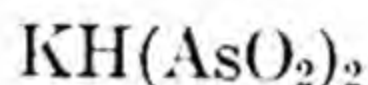
I-1778

A flocculent precipitate of strontium tetrarsenite is formed when concentrated solutions of strontium nitrate and potassium hydrogen metarsenite react.



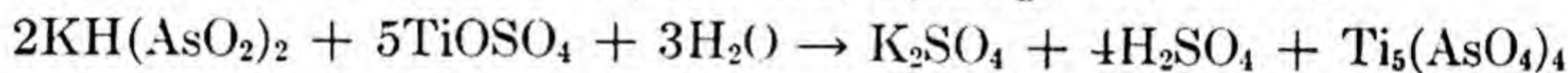
Reichard, Ber., **27**, 1019 (1894)

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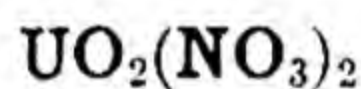
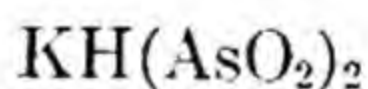
I-1779

A titanium arsenate is obtained if a neutral solution of titanyl sulfate is treated with an excess of potassium hydrogen metarsenite.



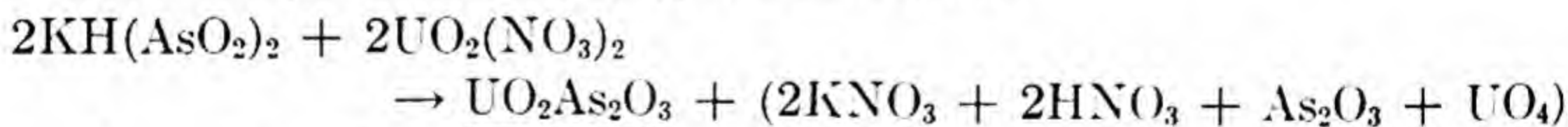
Reichard, Ber., **27**, 1019 (1894)

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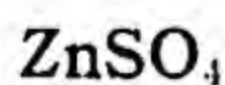
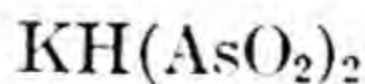
I-1780

A bright yellow precipitate forms when a solution of uranyl nitrate reacts with potassium hydrogen metarsenite.



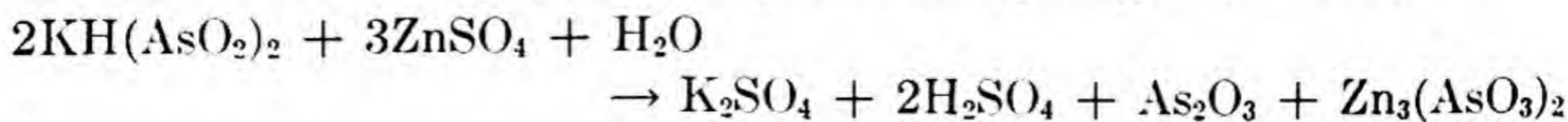
Reichard, Ber., **27**, 1019 (1894)

25



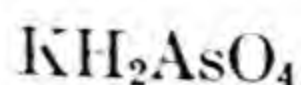
I-1781

A crystalline precipitate of zinc arsenite was formed when a solution of zinc sulfate was treated with potassium hydrogen metarsenite.



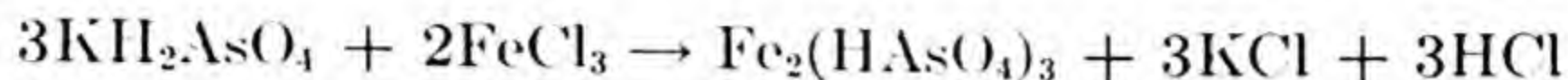
Reichard, Ber., **27**, 1019 (1894)

25



I-1782

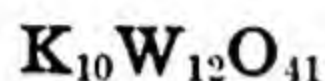
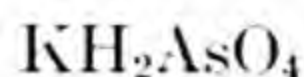
Ferric hydrogen arsenate is formed when ferric chloride reacts with potassium dihydrogen arsenate in the presence of potassium thiocyanate.



Franceschi, L'Orosi Boll. chim. farm., **15**, 192

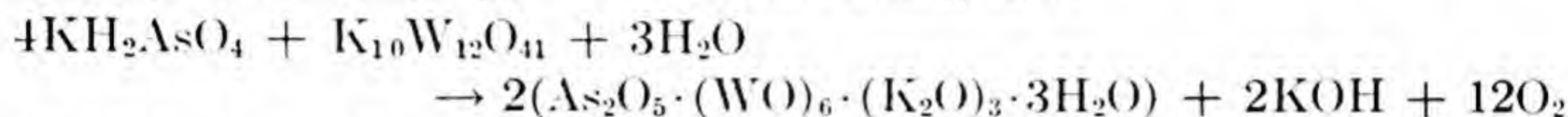
Ref., Metzke, Z. anorg. Chem., **19**, 457 (1899)

25



I-1783

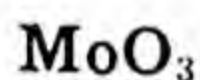
A complex salt is obtained when potassium dihydrogen arsenate in solution reacts with potassium dodecatungstate.



W. Gibbs, Proc. Am. Acad., **16**, 134

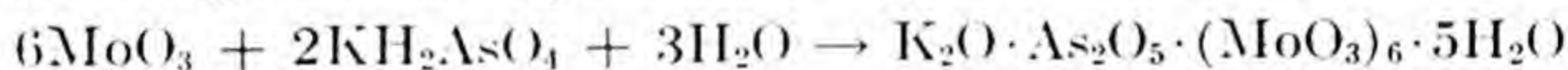
Ref., Ann., **245**, 50 (1888)

1



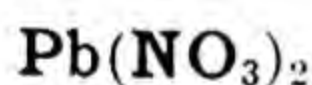
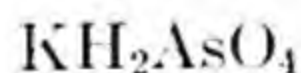
I-1784

A crystalline precipitate is formed when molybdenum trioxide reacts with a boiling solution of potassium dihydrogen arsenate.



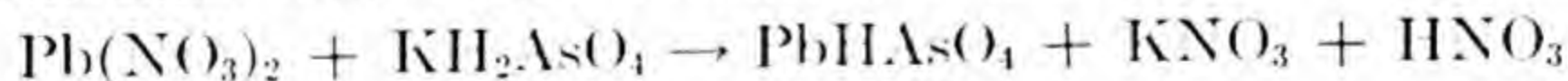
C. Friedheim, Z. anorg. Chem., **2**, 314 (1892)

28



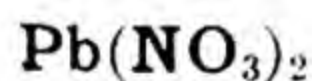
I-1785

Lead hydrogen arsenate results when a solution of potassium dihydrogen arsenate reacts with a solution of lead nitrate.



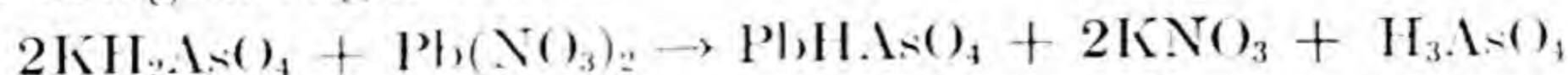
McDonnell and Smith, J. Am. Chem. Soc., **38**, 2028 (1916)

1



I-1786

Lead hydrogen arsenate was precipitated by the addition of a solution of lead nitrate to a solution of potassium dihydrogen arsenate, the latter being in slight excess.

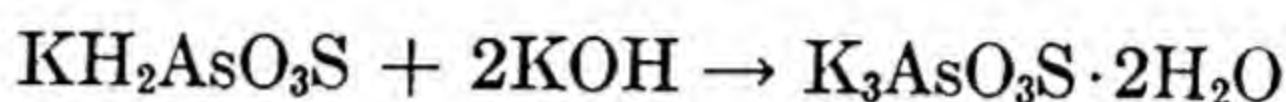


R. C. Roark, J.A.O.A.C., **3**, 332 (1920)

42

**KOH****I-1787**

Large colorless, prismatic, very hygroscopic crystals of pure dihydrated potassium thioarsenate are prepared by dissolving potassium dihydrogen thioarsenate in concentrated, carbon dioxide-free potassium hydroxide. By evaporating over concentrated sulfuric acid the pentahydrated salt is obtained.

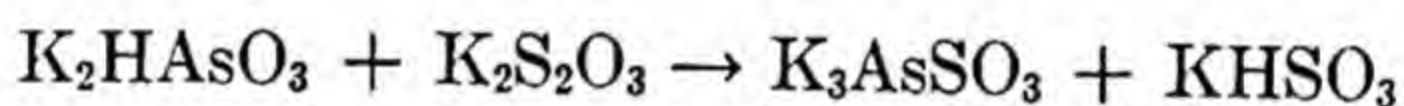


Weinland and Rumpf, *Z. anorg. Chem.*, **14**, 42 (1897)

28

**K₂S₂O₃****I-1788**

Crystals are formed when a concentrated solution of dipotassium hydrogen arsenite reacts with a concentrated solution of potassium thiosulfate.

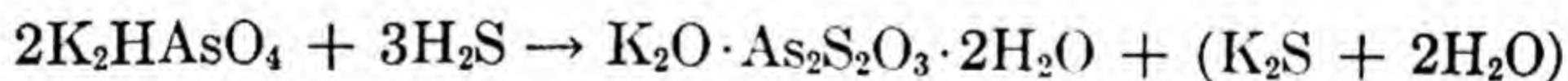


R. F. Weinland and A. Gutmann, *Z. anorg. Chem.*, **17**, 409 (1898)

28

**H₂S****I-1789**

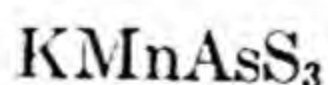
Colorless crystals of potassium oxythioarsenate are obtained when hydrogen sulfide is passed into a saturated solution of potassium hydrogen arsenate.



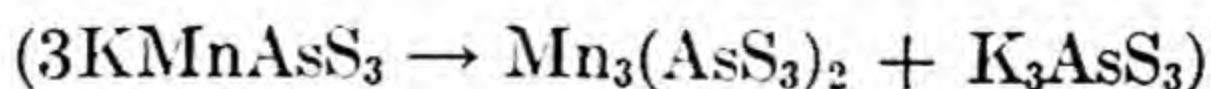
Bonquet and Cloez, *Ann. Chim. Phys.*, [3], **13**, 44

Ref., K. Preis, *Ann.*, **257**, 178 (1890)

25

**Air****I-1790**

Potassium manganous thioarsenite is unstable and breaks down in the presence of air according to the equation:

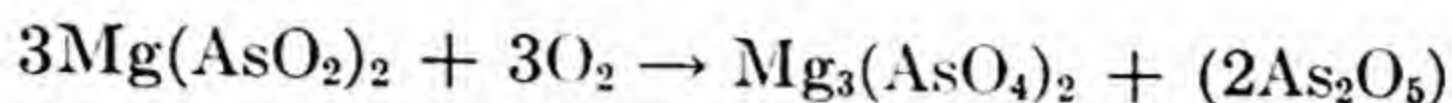


Wunchendorff and Valier, *Bull. Soc. Chim.*, [4], **51**, 1531 (1932)

31

O₂ **I-1791**
 $\text{Mg}(\text{AsO}_2)_2$

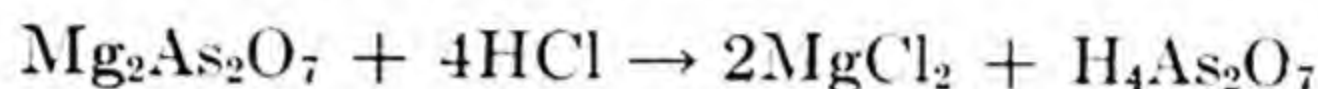
Magnesium metarsenite is partially oxidized to magnesium arsenate when ignited on a platinum foil.



Simon, Ann., **23**, 283 (1837)

HCl **I-1792**
 $\text{Mg}_2\text{As}_2\text{O}_7$

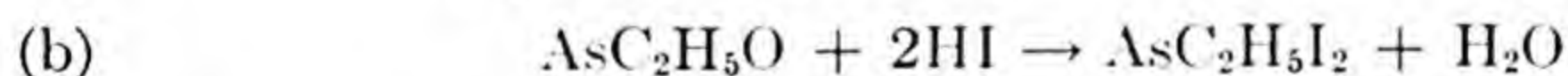
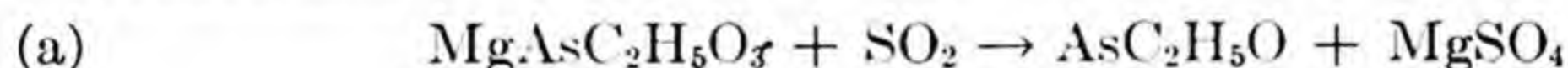
Magnesium pyroarsenate is converted into the corresponding acid when heated in a stream of hydrogen chloride.



Smith and Hibbs, J. Am. Chem. Soc., **17**, 684 (1895)

SO₂ **I-1793**
HI
 $\text{MgAsC}_2\text{H}_5\text{O}_3$

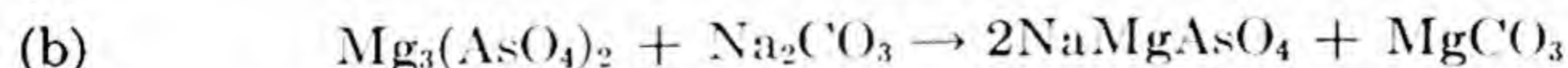
To an aqueous solution of magnesium acetoarsine 10 grams of iodine are added and a current of sulfur dioxide is passed through the solution for several hours, (a). A canary yellow precipitate of diiodoethylarsine is formed, (b). Hydrogen iodide is responsible for the formation of ethyldiiodoarsine.



Alex. McKenzie and John K. Wood, J. Chem. Soc., (London), **117**, 407, 408 (1920) 48

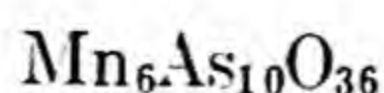
Na₂CO₃ **I-1794**
 $\text{MgNH}_4\text{AsO}_4$

Magnesium ammonium arsenate decomposes upon heating to yield magnesium arsenate, (a), which in turn reacts with sodium carbonate to yield the double salt shown in (b).



H. Rose, Pogg. Ann., **77**, 300

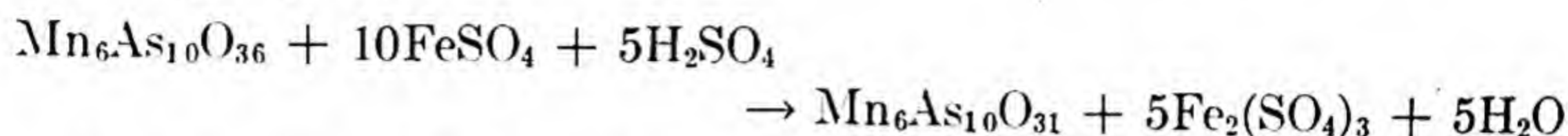
Ref., Ann., **72**, 259 (1849)



I-1795

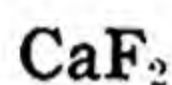
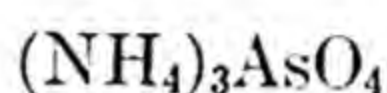


The product of the reaction between arsenious acid and permanganic acid reacts with ferrous sulfate in sulfuric acid solution according to the following equation:



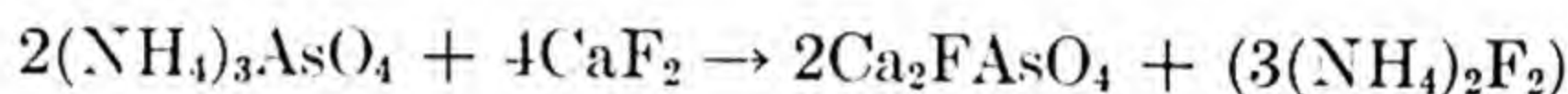
L. Bertiaux, Bull. Soc. Chim. [IV], **35**, 1341 (1924)

31



I-1796

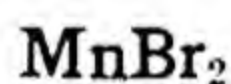
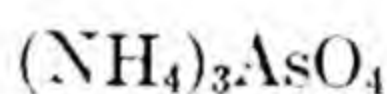
Calcium fluoarsenate is formed when calcium fluoride reacts with ammonium arsenate.



A. Ditte, Compt. rend., **99**, 967

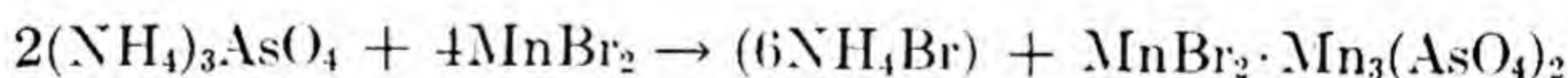
Ref., Ber., **18**, 4 (1885)

25



I-1797

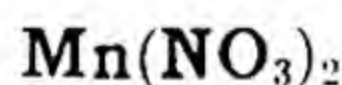
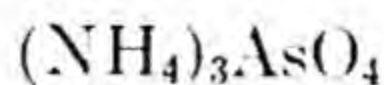
Manganese bromide arsenate is obtained as prisms or long transparent needles when ammonium arsenate is melted with a large excess of manganous bromide.



A. Ditte, Compt. rend., **96**, 846

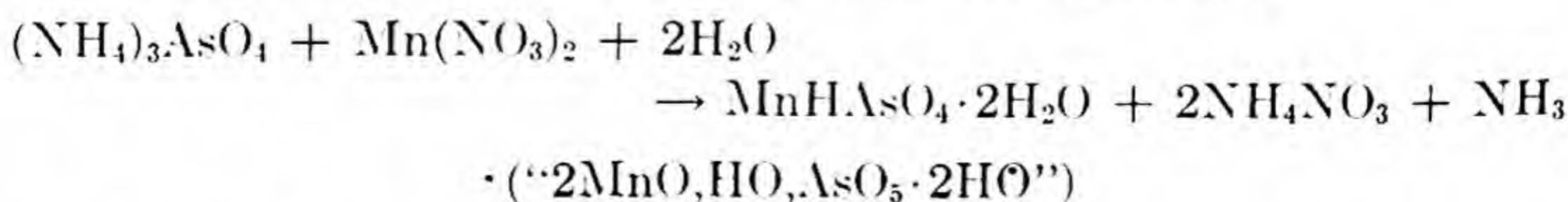
Ref., Ber., **16**, 1097 (1883)

25



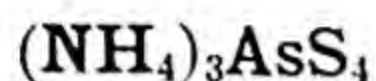
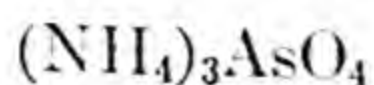
I-1798

When ammonium arsenate is treated with a manganese salt for several days at a temperature of 100°, a crystalline salt is formed.



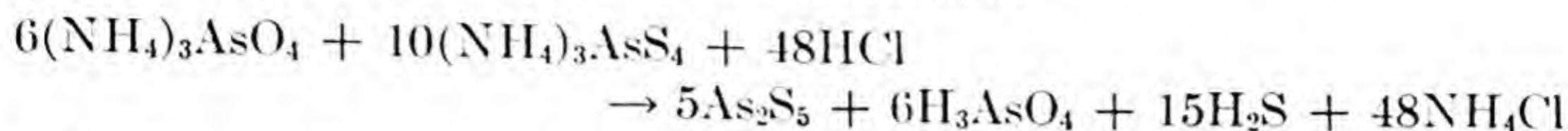
H. Debray, Compt. rend., **59**, 43 (1864)

29



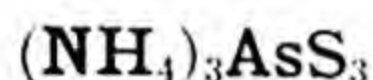
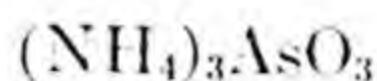
I-1799

Arsenic pentasulfide forms when a mixture of ammonium arsenate and thioarsenate is treated with hydrochloric acid.



L. Vanino and C. Griebel, *Z. anal. Chem.*, **40**, 589 (1901)

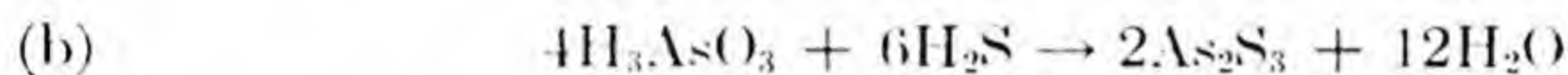
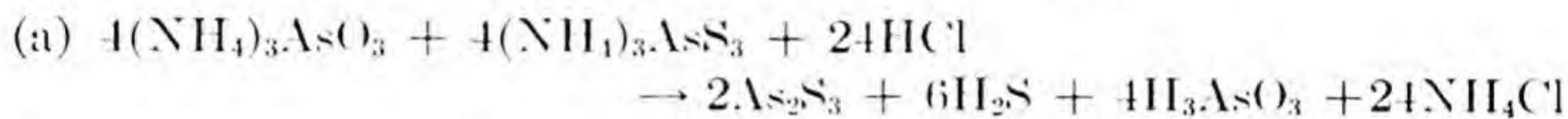
25



I-1800

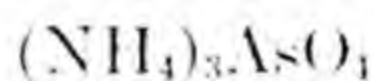


Arsenic trisulfide precipitates when a mixture of ammonium arsenite and thioarsenite is treated with hydrochloric acid.



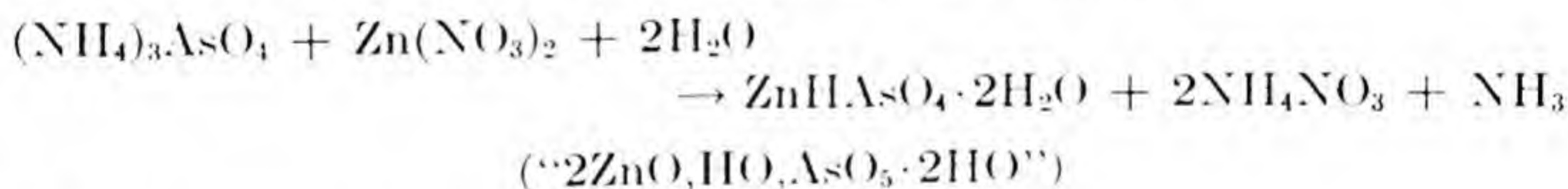
L. Vanino and C. Griebel, *Z. anal. Chem.*, **40**, 589 (1901)

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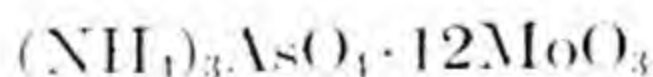
I-1801

When ammonium arsenate is treated with an excess of a zinc salt for about five days at 100° , a crystalline salt is obtained.



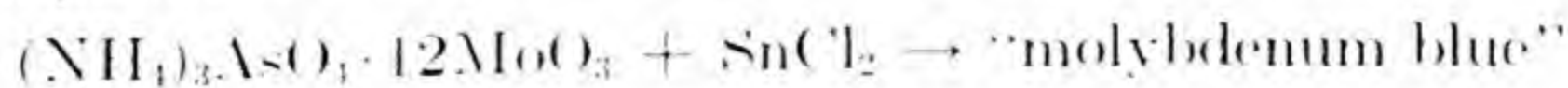
H. Debray, *Compt. rend.*, **59**, 43 (1864)

29



I-1802

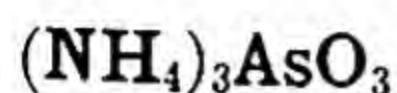
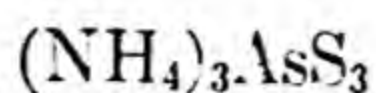
Reduction of molybdoarsenate by stannous chloride in dilute acid solution produces a blue coloration, molybdenum blue.



Deniges, *Compt. rend.*, **171**, 802 (1920)

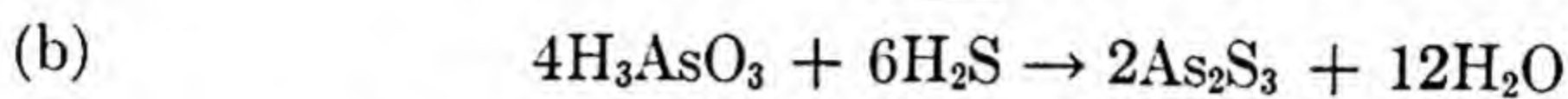
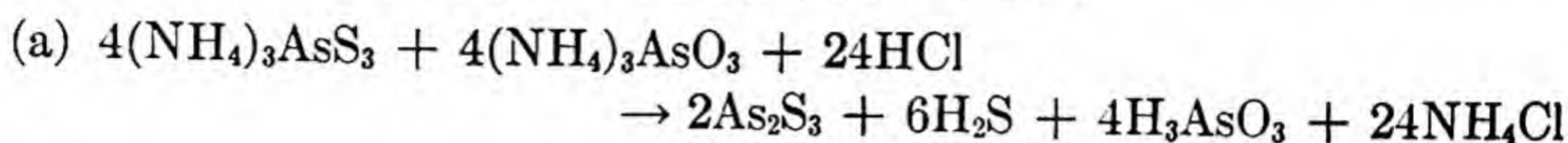
Ref., E. Truog, and A. H. Meyer, *Ind. Eng. Chem., Anal. Ed.*, **1**, 136 (1929)

33



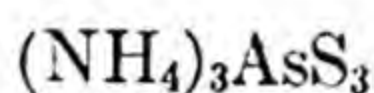
I-1803

Arsenic trisulfide precipitates when a mixture of ammonium arsenite and thioarsenite is treated with hydrochloric acid.



L. Vanino and C. Griebel: *Z. anal. Chem.*, **40**, 589 (1901)

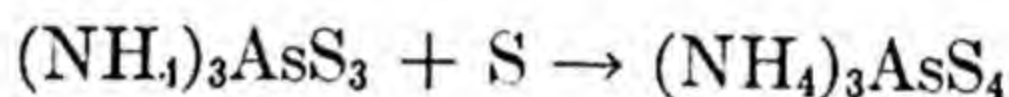
25



S

I-1804

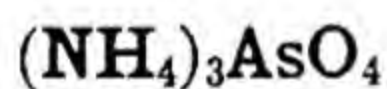
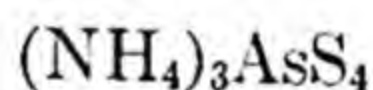
Ammonium thioarsenate is formed when an aqueous solution of ammonium thioarsenite is digested with precipitated sulfur under pressure.



Weinland and Rumpf, *Ber.*, **29**, 1008 (1896)

Ref., *J. Chem. Soc.*, (London) **70**, 473 (1896)

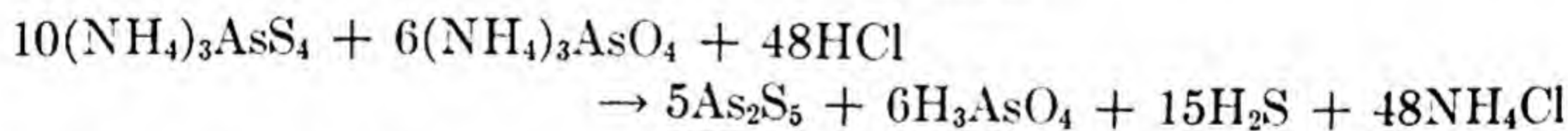
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I-1805

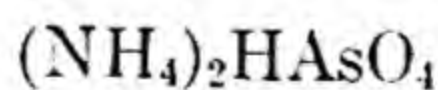
HCl

Arsenic pentasulfide forms when a mixture of ammonium arsenate and thioarsenate is treated with hydrochloric acid.



L. Vanino and C. Griebel: *Z. anal. Chem.*, **40**, 589 (1901)

25

FeCl₃

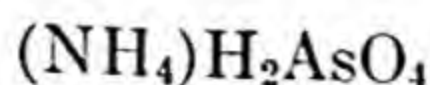
I-1806

A white precipitate is formed when a hot solution of diammonium arsenate is added to a solution of ferric chloride, made acid with hydrochloric acid and the solution heated.

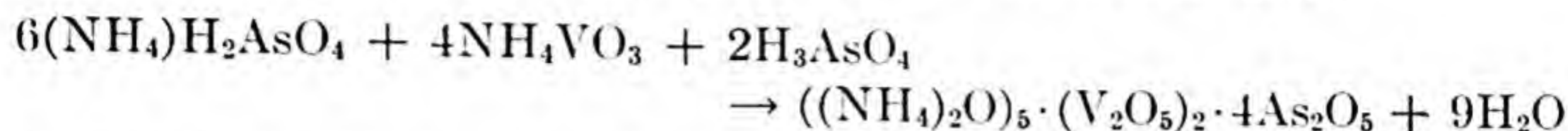


L. J. Curtman, *J. Am. Chem. Soc.*, **32**, 627 (1910)

1

**I-1807**

A double compound is formed when ammonium vanadate is allowed to react with ammonium dihydrogen arsenate and arsenic acid.

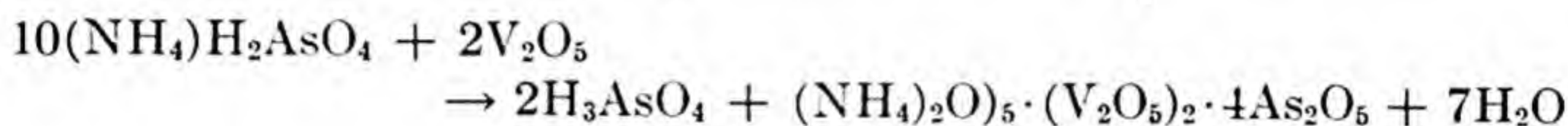


C. Friedheim, Ber., **23**, 2600 (1890)

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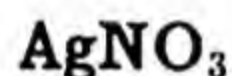
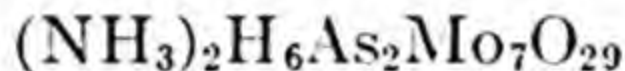
**I-1808**

A double compound is formed when vanadium pentoxide is allowed to react with ammonium dihydrogen arsenate.

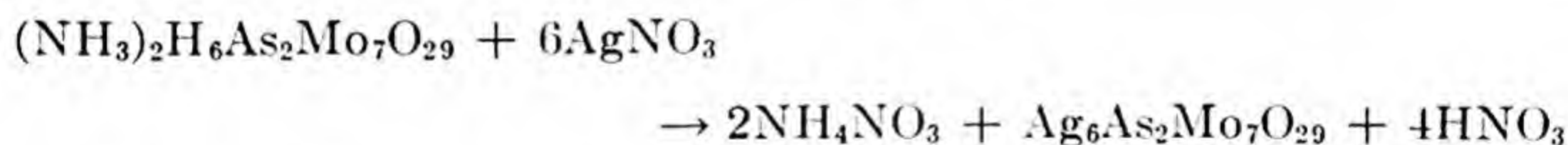


Friedheim, Ber., **23**, 2600 (1890)

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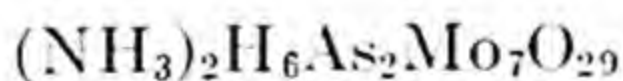
**I-1809**

When the above complex salt is treated with an excess of silver nitrate a clear yellow silver arsenomolybdate is formed.

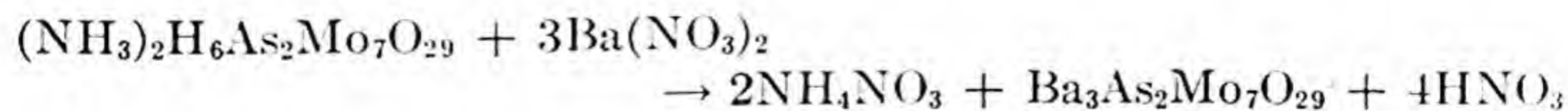


H. Seyberth, Ber., **7**, 319 (1874)

11

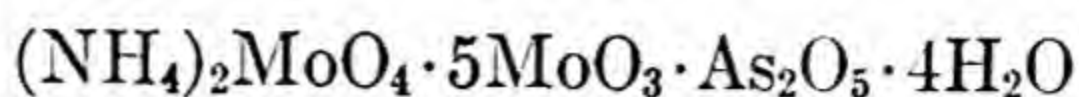
**I-1810**

When the above complex salt is treated with barium salts a white precipitate is formed.

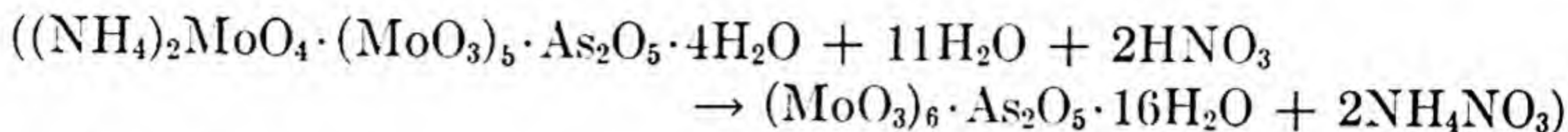


H. Seyberth, Ber., **7**, 391 (1874)

11

**Aqua regia****I-1811**

Aqua regia reacts with ammonium arsenomolybdate to form the free acid which is a white crystalline compound.



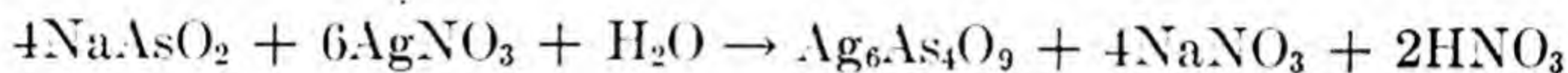
H. Debray,

Ref.: A. Henninger, Ber., 7, 820 (1874)

11

**AgNO₃****I-1812**

A yellow precipitate is formed when a solution of sodium metarsenite is treated with an excess of a solution of silver nitrate.

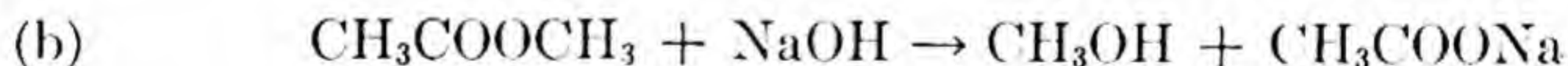
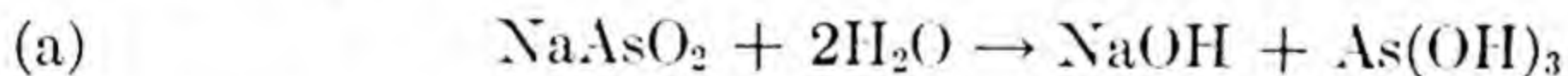


C. Reichard, Ber., 31, 2163 (1898)

25

**CH₃COOCH₃****I-1813**

When a solution of sodium metarsenite and methyl acetate are mixed, the product of hydrolysis of the metarsenite saponifies the ester. The hydrolysis proceeds to about 1.4%.

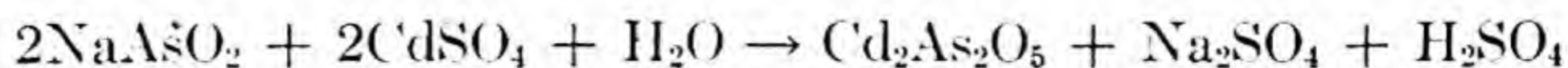


J. K. Wood, J. Chem. Soc., (London), 93, 415 (1908)

57

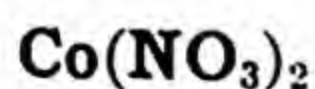
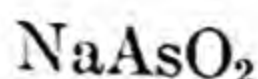
**CdSO₄****I-1814**

A white flocculent precipitate of cadmium pyroarsenite is formed when a solution of sodium metarsenite is treated with an excess of cadmium sulfate solution.



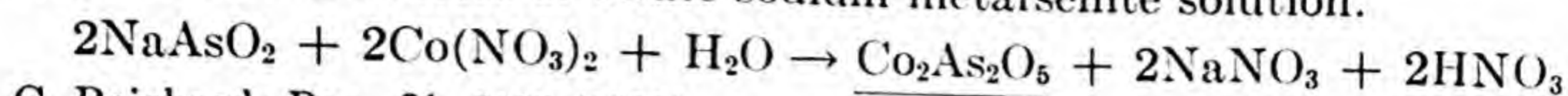
C. Reichard: Ber., 31, 2163 (1898)

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I-1815

A blue compound is obtained when a solution of cobaltous nitrate is treated with an excess of dilute sodium metarsenite solution.



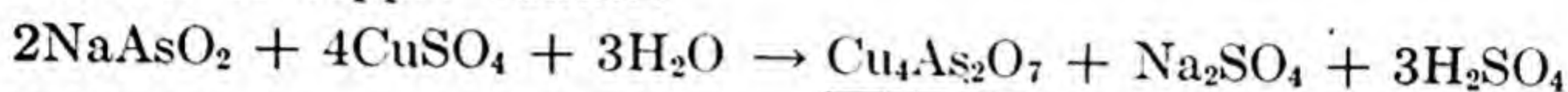
C. Reichard: Ber., **31**, 2163 (1898)

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I-1816

A bright green amorphous precipitate of copper pyroarsenate is formed when a solution of sodium arsenite is treated with an excess of a solution of copper sulfate.



C. Reichard: Ber., **31**, 2163 (1898)

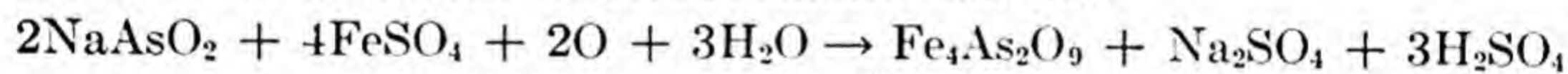
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I-1817

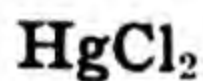
O

A bright green voluminous precipitate, changing into a yellowish-red color in the air, is formed when a solution of sodium metarsenite is treated with an excess of ferrous sulfate solution.



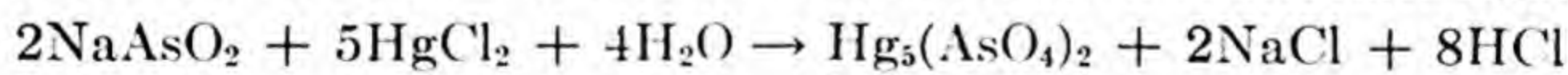
C. Reichard: Ber., **31**, 2163 (1898)

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I-1818

A white precipitate is formed when a solution of sodium metarsenite is treated with an excess of a concentrated solution of mercuric chloride.

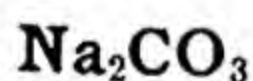


C. Reichard: Ber., **31**, 2163 (1898)

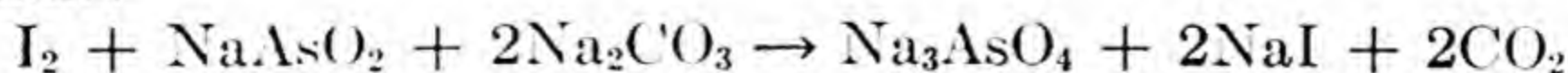
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I-1819

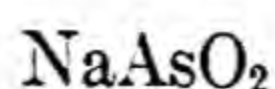


In presence of a carbonate, iodine and arsenite react to form arsenate and iodide.



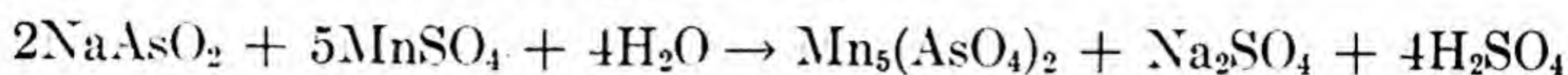
J. E. Mackenzie and H. Marshall, J. Chem. Soc., (London), **93**, 1728 (1908)

57



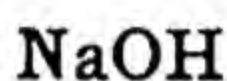
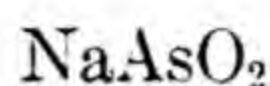
I-1820

A white precipitate which soon becomes red and finally brown is formed when a solution of sodium metarsenite is treated with an excess of a solution of manganous sulfate.



C. Reichard: Ber., **31**, 2163 (1898)

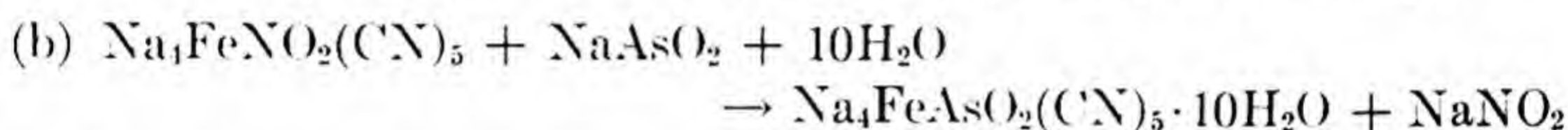
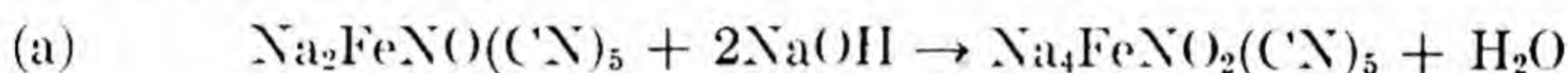
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I-1821

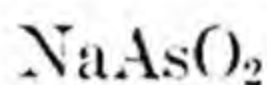


A solution of sodium nitroprusside will give quaternary sodium nitroprusside which in turn will react with a solution of sodium arsenite yielding needles of yellow color.



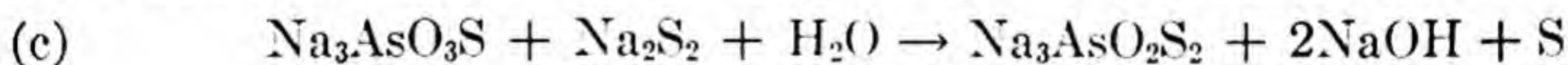
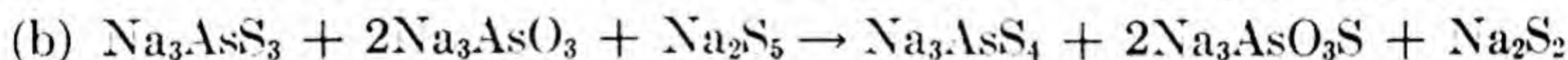
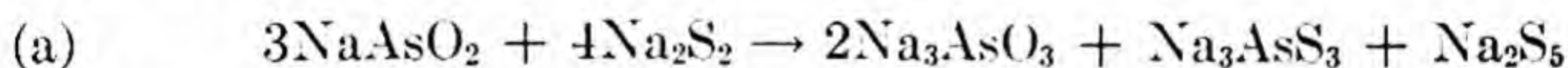
K. A. Hofmann, Z. Anorg. Chem., **12**, 146 (1896)

28



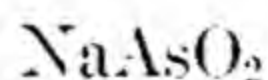
I-1822

Crystals of sodium dithiodioxyarsenate are obtained when a very concentrated solution of sodium metarsenite reacts with a very concentrated solution of sodium disulfide.



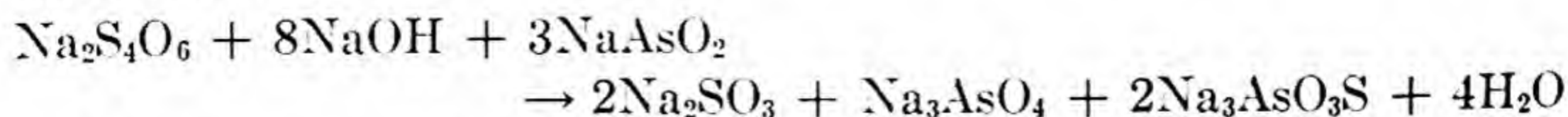
R. F. Weinland and O. Rumpf, Z. anorg. Chem., **14**, 42 (1897)

28



I-1823

An alkaline solution of sodium metarsenite reacts with sodium tetrathionate to form: sodium sulfite, sodium arsenate, and sodium monothioarsenate.

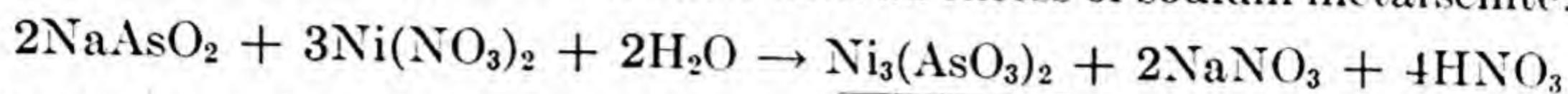


J. O. Mackenzie and H. Marshall, J. Chem. Soc., (London), **93**, 1728 (1908)

102

Ni(NO₃)₂NaAsO₂**I-1824**

A bright green precipitate of nickel orthoarsenite is obtained when a solution of nickel nitrate is treated with an excess of sodium metarsenite.

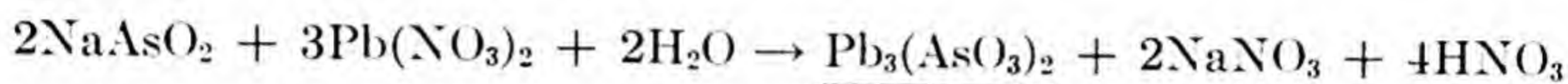


C. Reichard: Ber., **31**, 2163 (1898)

25

Pb(NO₃)₂NaAsO₂**I-1825**

A heavy white precipitate of lead orthoarsenite is formed when a solution of sodium metarsenite is treated with an excess of lead nitrate solution.

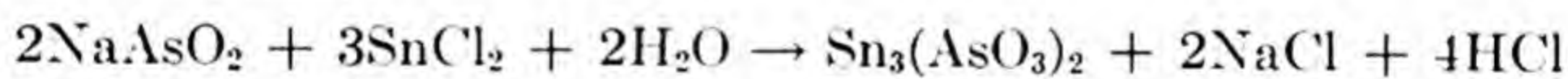


C. Reichard: Ber., **31**, 2163 (1898)

25

SnCl₂NaAsO₂**I-1826**

A white curdy precipitate of stannous orthoarsenite is formed when a solution of sodium metarsenite is treated with an excess of stannous chloride solution.

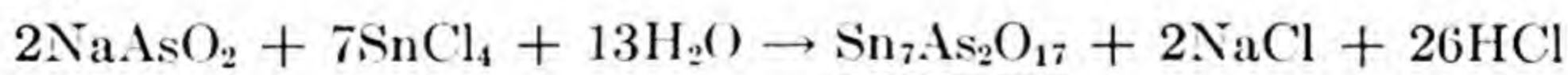


C. Reichard: Ber., **31**, 2163 (1898)

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SnCl₄NaAsO₂**I-1827**

A voluminous yellowish white precipitate is formed when a solution of sodium metarsenite is treated with an excess of a solution of stannic chloride.

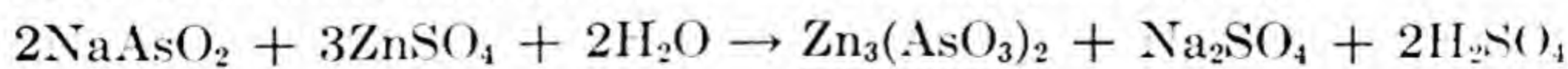


C. Reichard: Ber., **31**, 2163 (1898)

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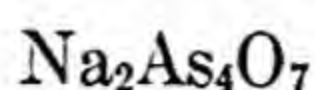
ZnSO₄NaAsO₂**I-1828**

A precipitate of zinc orthoarsenite is formed when a solution of sodium arsenite is treated with an excess of zinc sulfate solution.



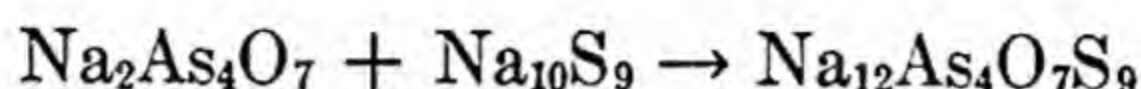
C. Reichard: Ber., **31**, 2163 (1898)

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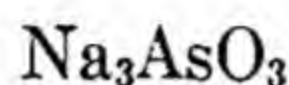
I-1829

A salt is formed when sodium polysulfide reacts with sodium pyroarsenate.



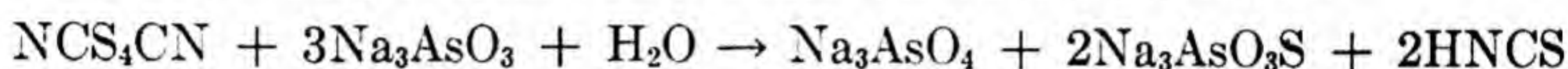
Weinland and Rumpf, *Z. anorg. Chem.*, **14**, 42 (1897)

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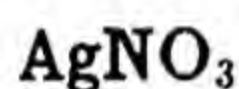
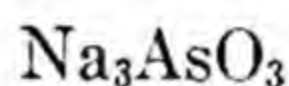
I-1830

Dicyanogen tetrasulfide dissolved in chloroform will react with sodium arsenite yielding sodium thioarsenate and sodium arsenate.



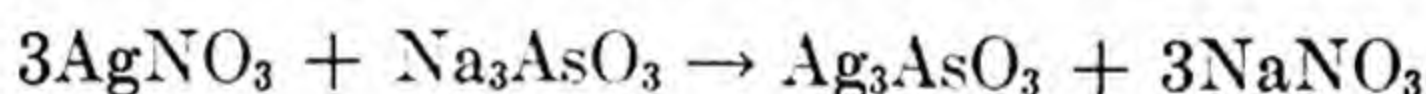
A. Gutmann, *Z. anal. Chem.*, **66**, 224 (1925)

28



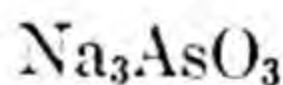
I-1831

Silver arsenite is prepared by treating a solution of sodium arsenite, acidified with nitric acid, with an excess of silver nitrate solution.



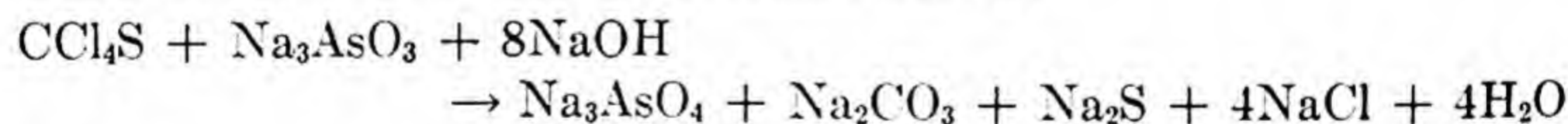
G. W. Sears, *J. Am. Chem. Soc.*, **43**, 466 (1921)

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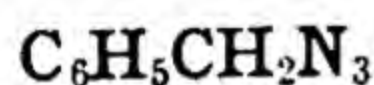
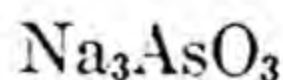
I-1832

Perchloric methylmercaptan will react with sodium arsenite in presence of sodium hydroxide yielding sodium arsenate.



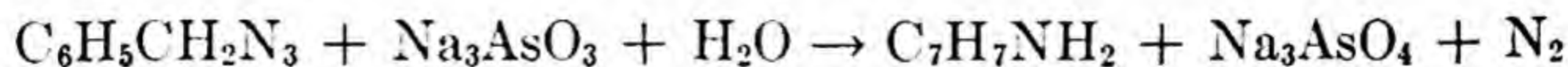
A. Gutmann, *Z. anal. Chem.*, **71**, 144 (1927)

28



I-1833

Benzyl triazide dissolved in alcohol will react with sodium arsenite yielding sodium arsenate and benzylamine.

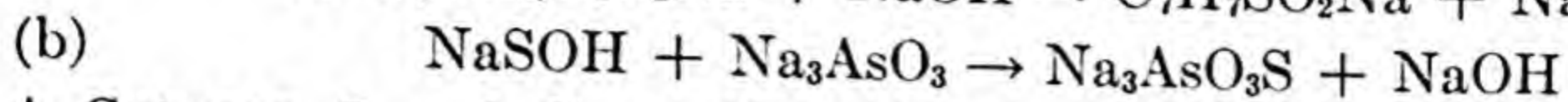
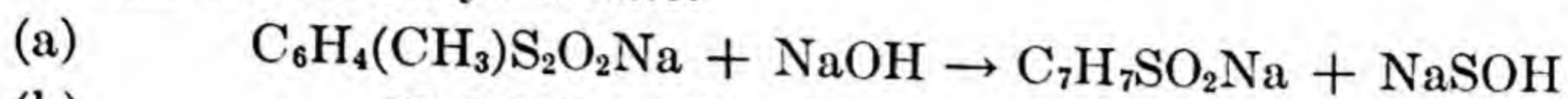


A. Gutmann, *Z. anal. Chem.*, **66**, 224 (1925)

28

C₆H₄(CH₃)S₂O₂Na**I-1834**

Sodium toluene thiosulfonate reacts with sodium arsenite yielding sodium monothioxyarsenate.

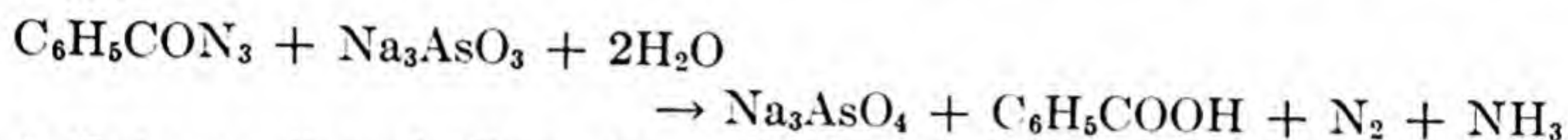


A. Gutmann, Z. anal. Chem., **66**, 224 (1925)

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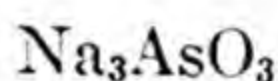
**C₆H₅CON₃****I-1835**

Benzoyl triazide will react with sodium arsenite yielding sodium arsenate.

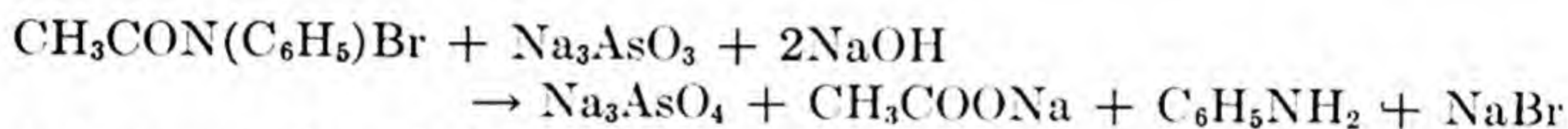


A. Gutmann, Z. anal. Chem., **66**, 224 (1925)

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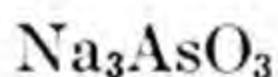
**CH₃CON(C₆H₅)Br****I-1836**

Acetyl bromaminobenzene will react with sodium arsenite yielding sodium arsenate.

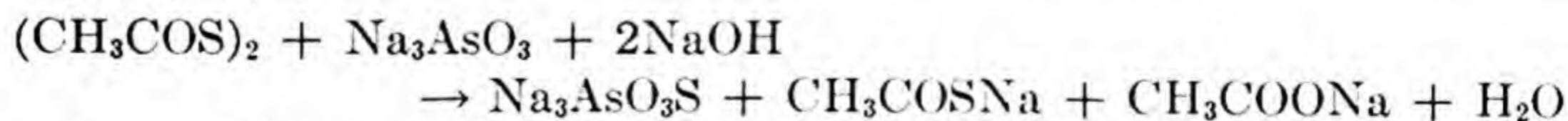


A. Gutmann, Z. anal. Chem., **65**, 250 (1924)

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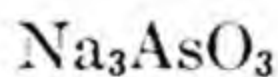
**(CH₃COS)₂****I-1837**

Diacetyl disulfide reacts with sodium arsenite yielding sodium monothioarsenate.

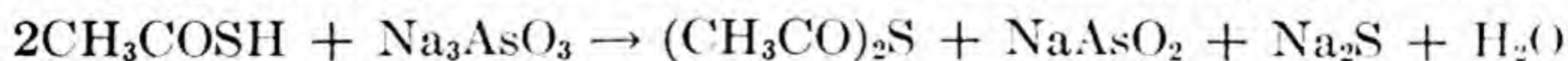


A. Gutmann, Z. anal. Chem., **66**, 224 (1925)

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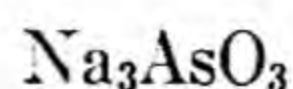
**CH₃COSH****I-1838**

Thioacetic acid under ordinary conditions reduces sodium arsenite to give acetyl sulfide, sodium metarsenite, sodium sulfide and water.



N. Tarugi, Gazz. Chim. Ital., **27**², 157 (1897)

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 CHI_3

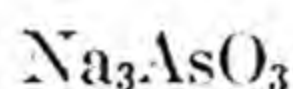
I-1839

Methylene iodide is formed quantitatively when iodoform is reacted with a boiling solution of trisodium arsenite.



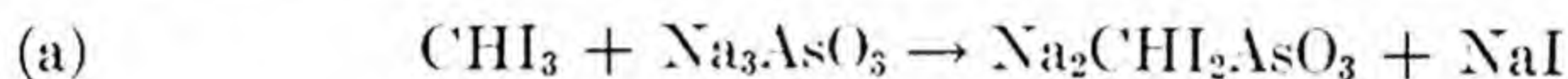
H. Klinger and V. von Richter, "Organische Chemie, 10th Ed., vol. I, 230
Ref.: Auger, Compt. rend., **146**, 1281 (1908)

38


 CHI_3

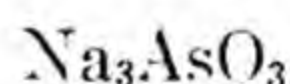
I-1840

When iodoform is reacted with a boiling solution of trisodium arsenite, obtained by dissolving 1 mole of arsenic trioxide in 6 moles of sodium hydroxide, sodium diiodomethylarsinite is formed (a) which, under the conditions of the reaction, immediately decomposes with the excess alkali present and yields methylene iodide and sodium arsenate (b).



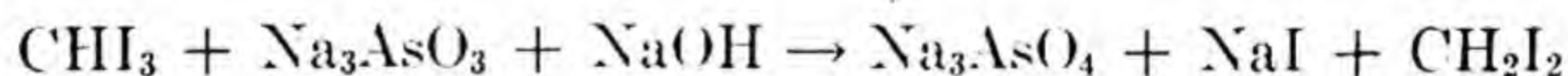
Auger, Compt. rend., **146**, 1281-2 (1908)

38


 CHI_3

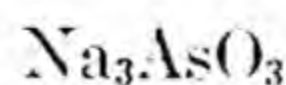
I-1841

Iodoform will react with sodium arsenite yielding sodium arsenate and methylene iodide.



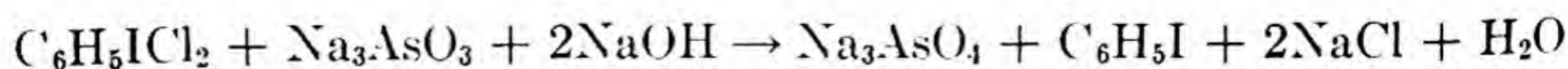
A. Gutmann, Z. anal. Chem., **65**, 248 (1924)

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 $\text{C}_6\text{H}_5\text{ICl}_2$

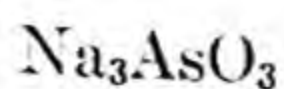
I-1842

Phenyl iododichloride will react with sodium arsenite yielding sodium arsenate.



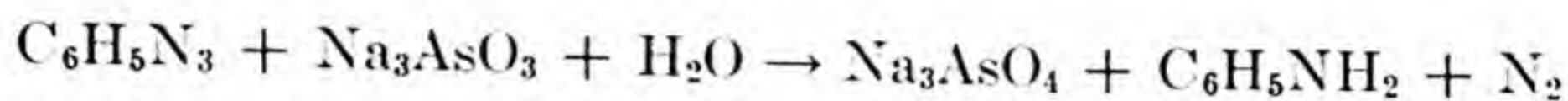
A. Gutmann, Z. anal. Chem., **65**, 250 (1924)

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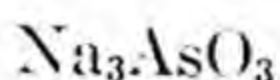
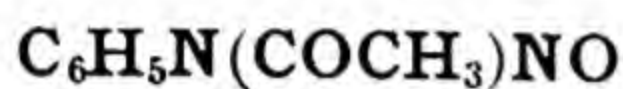
I-1843

Phenyl triazide reacts with sodium arsenite yielding sodium arsenate and aniline.



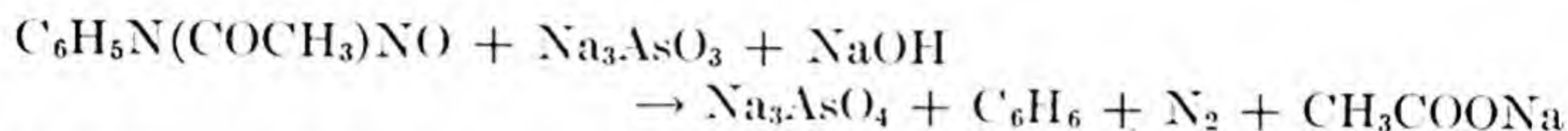
A. Gutmann, Z. anal. Chem., **66**, 224 (1925)

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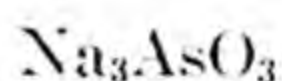
I-1844

Nitroso acetanilide will react with sodium arsenite yielding sodium arsenate.



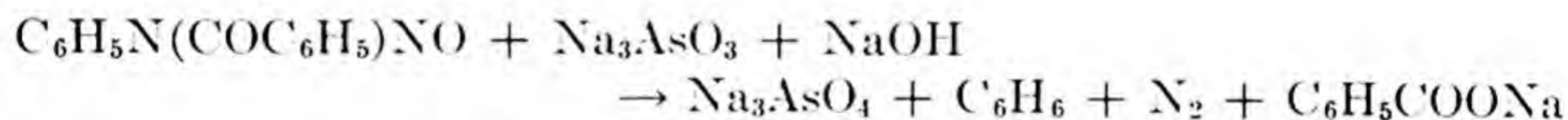
A. Gutmann, Z. anal. Chem., **66**, 224 (1925)

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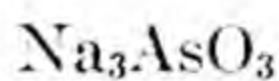
I-1845

Benzoyl-phenylnitrosamine will react with sodium arsenite yielding sodium arsenate.



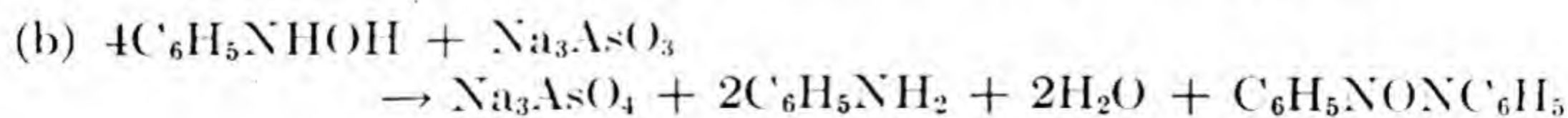
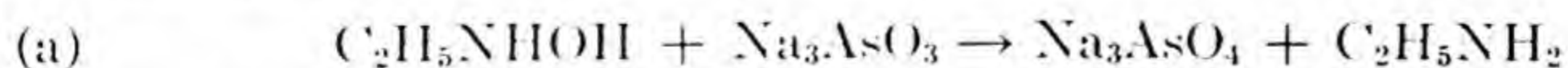
A. Gutmann, Z. anal. Chem., **66**, 224 (1925)

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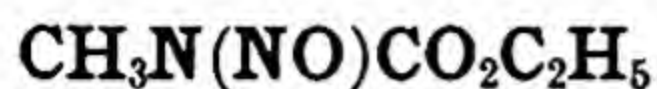
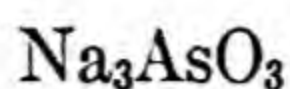
I-1846

Beta-ethylhydroxylamine will react with sodium arsenite yielding sodium arsenate and ethylamine. Or the reaction may yield azoxybenzene and aniline besides sodium arsenate.



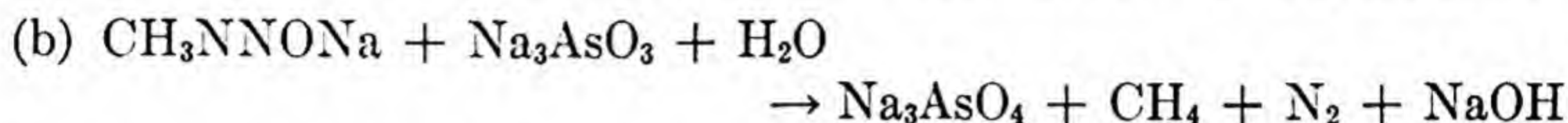
A. Gutmann, Z. anal. Chem., **66**, 224 (1925)

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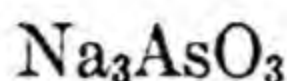
I-1847

Nitroso methylurethane will react with sodium arsenite in presence of sodium hydroxide yielding sodium arsenate.



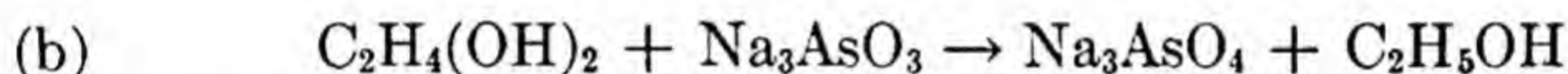
A. Gutmann, Z. anal. Chem., **66**, 224 (1925)

28



I-1848

Ethylnitrate will react with sodium arsenite in the presence of sodium hydroxide yielding sodium arsenate. Glycol appears to be an intermediate product.



A. Gutmann, Z. anal. Chem., **66**, 224 (1925)

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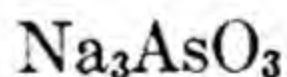
I-1849

Nitrosobenzene will react with sodium arsenite yielding sodium arsenate.



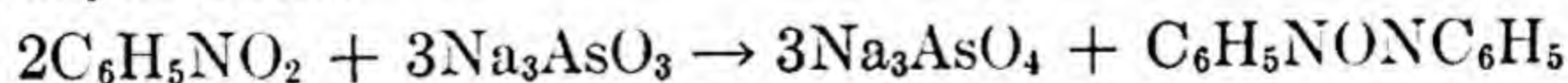
A. Gutmann, Z. anal. Chem., **66**, 224 (1925)

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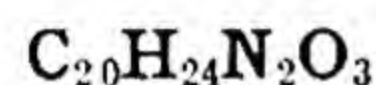
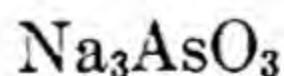
I-1850

Nitrobenzene will react with sodium arsenite yielding sodium arsenate and azoxybenzene.



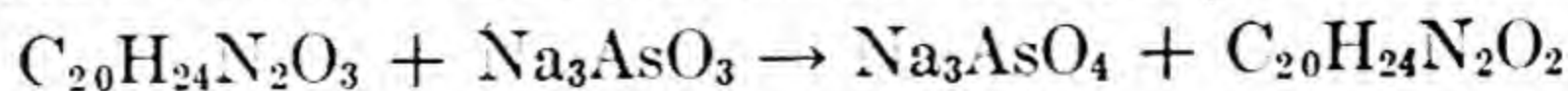
A. Gutmann, Z. anal. Chem., **66**, 224 (1925)

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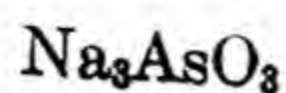
I-1851

Quinine oxide will react with sodium arsenite yielding sodium arsenate.



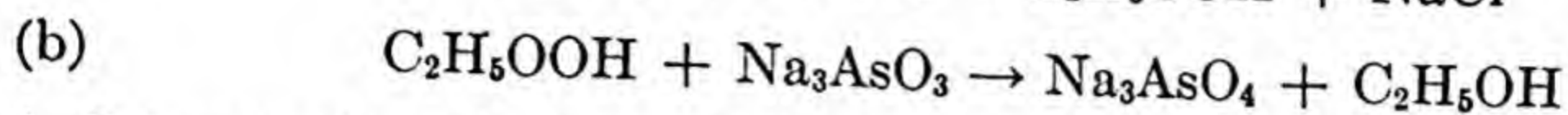
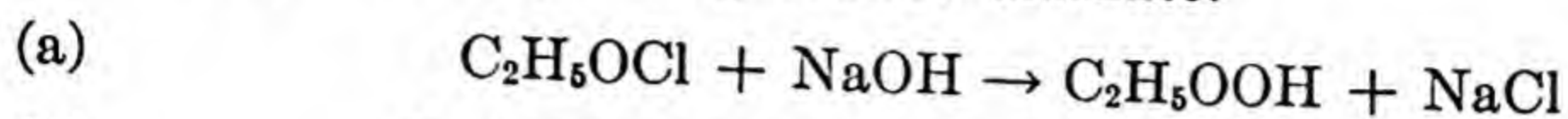
A. Gutmann, Z. anal. Chem., **66**, 224 (1925)

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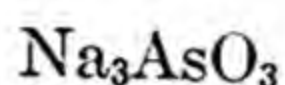
I-1852

Ethyl hypochlorite will react with sodium arsenite in presence of sodium hydroxide yielding sodium arsenate.



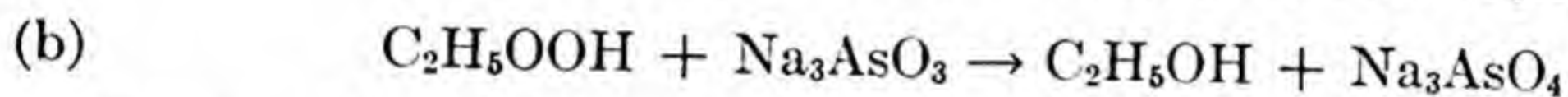
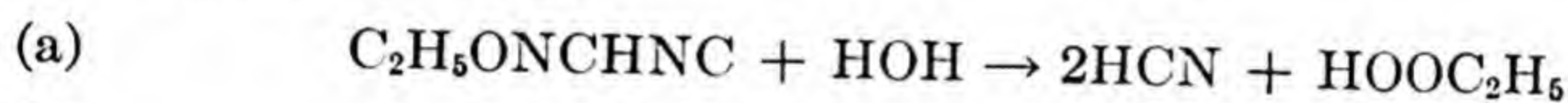
A. Gutmann, Z. anal. Chem., **66**, 224 (1925)

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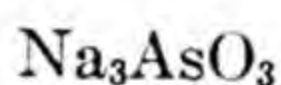
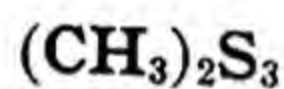
I-1853

Cyanicimidocarbonic acid ethyl ester will react with sodium arsenite yielding sodium arsenate.



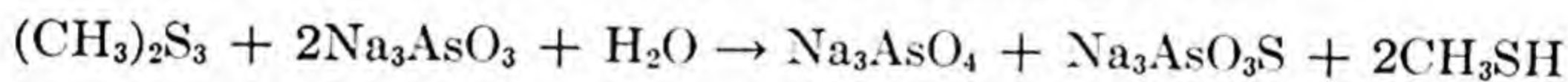
A. Gutmann, Z. anal. Chem., **66**, 224 (1925)

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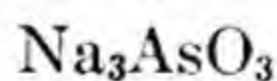
I-1854

Methyltrisulfide dissolved in alcohol will react with sodium arsenite yielding sodium monothioarsenate and sodium arsenate.



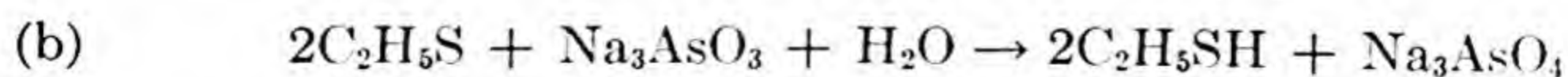
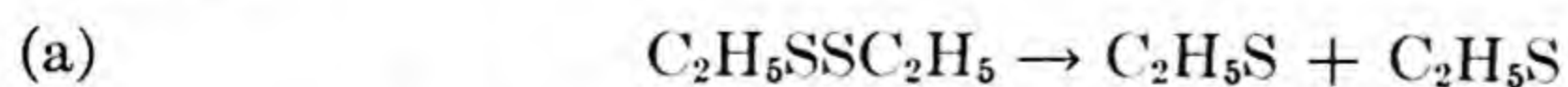
A. Gutmann, Z. anal. Chem., **66**, 224 (1925)

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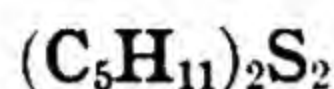
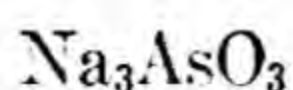
I-1855

Diethyldisulfide will react with sodium arsenite yielding sodium arsenate.



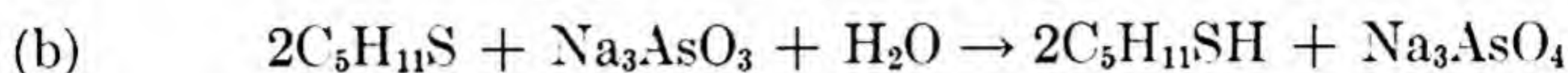
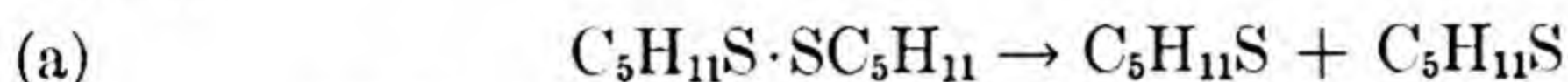
A. Gutmann, Z. anal. Chem., **66**, 224 (1925)

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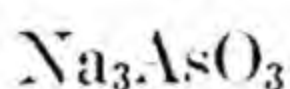
I-1856

Diamyldisulfide will react with sodium arsenite yielding sodium arsenate.



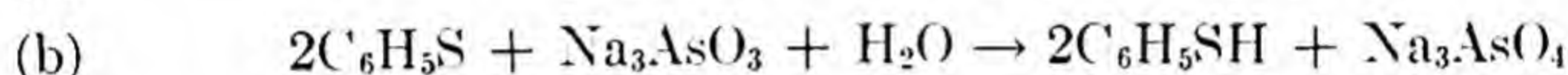
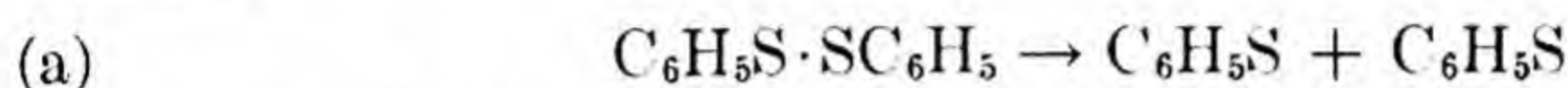
A. Gutmann, Z. anal. Chem., **66**, 224 (1925)

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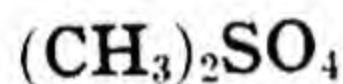
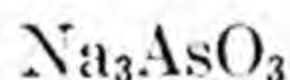
I-1857

Diphenyldisulfide will react with sodium arsenite yielding sodium arsenate.



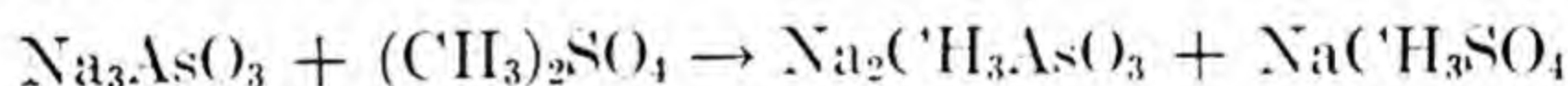
A. Gutmann, Z. anal. Chem., **66**, 224 (1925)

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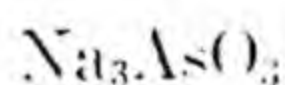
I-1858

Sodium arsenite is methylated by adding dimethyl sulfate. The temperature should be 85°C.



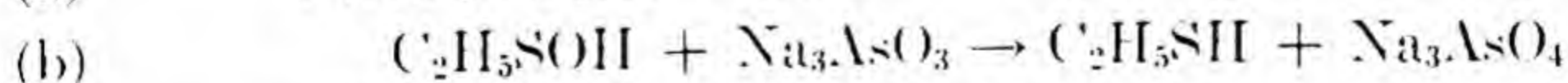
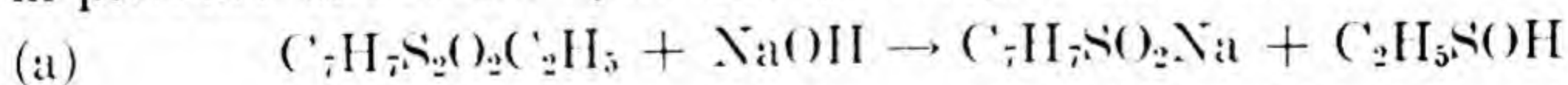
Uhlinger and Cook, J. Ind. Eng. Chem., **11**, 105 (1919)

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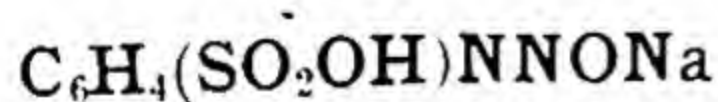
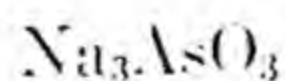
I-1859

Para-toluenethiosulfonic acid ethyl ester will react with sodium arsenite in presence of sodium hydroxide yielding sodium arsenate.



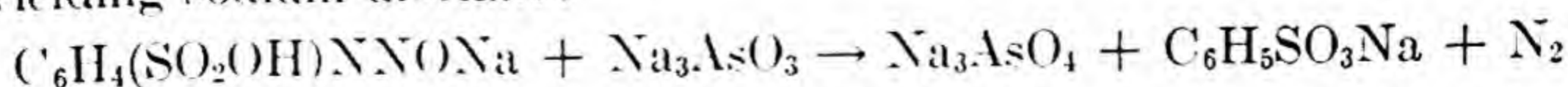
A. Gutmann, Z. anal. Chem., **66**, 224 (1925)

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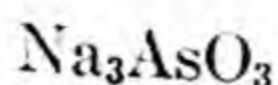
I-1860

Paradiazobenzene sodium sulfonate will react with sodium arsenite yielding sodium arsenate.

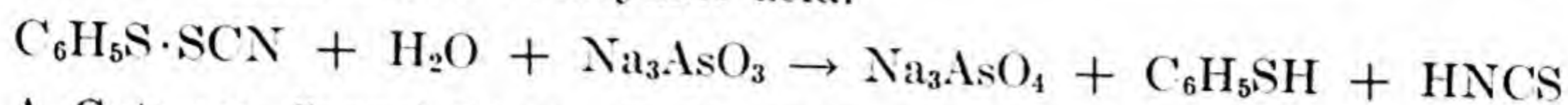


A. Gutmann, Z. anal. Chem., **66**, 224 (1925)

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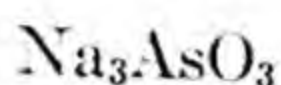
C₆H₅S·SCN**I-1861**

Phenyl cyanogen disulfide will react with sodium arsenite yielding sodium arsenate and thiocyanic acid.

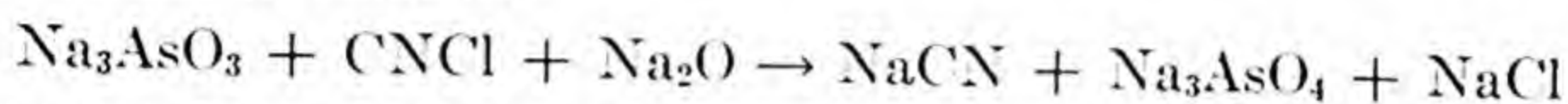


A. Gutmann, Z. anal. Chem., **66**, 224 (1925)

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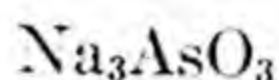
CNCl**I-1862****Na₂O**

Sodium arsenite is oxidized when treated with cyanogen chloride and sodium oxide in solution.



A. Gutmann: Ber., **42**, 3623 (1909)

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CNI**I-1863**

Cyanogen iodide will react with sodium arsenite and sodium oxide yielding sodium arsenate.

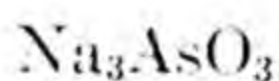


A. Gutmann, Z. anal. Chem., **65**, 253 (1924)

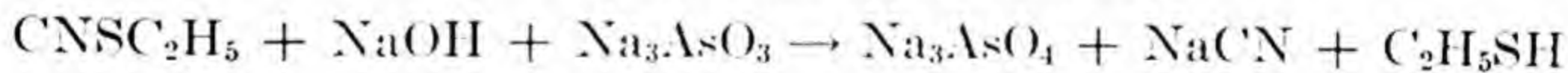
Ref., A. Gutmann, Ber., **42**, 3623 (1909)

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25

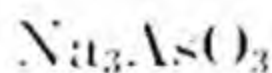
CNSC₂H₅**I-1864**

Ethylthiocyanate will react with sodium arsenite in presence of NaOH yielding sodium arsenate and ethyl hydrosulfide.

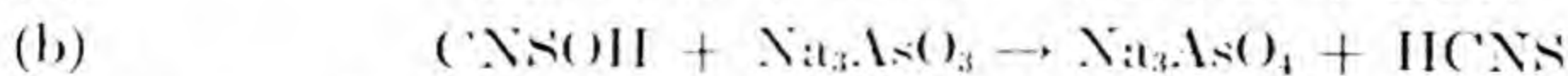


A. Gutmann, Z. anal. Chem., **66**, 224 (1925)

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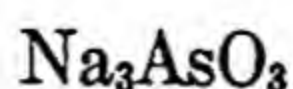
CNS·CN**I-1865**

Cyanogen sulfide dissolved in carbon disulfide will react with sodium arsenite yielding sodium arsenate and thiocyanic acid.



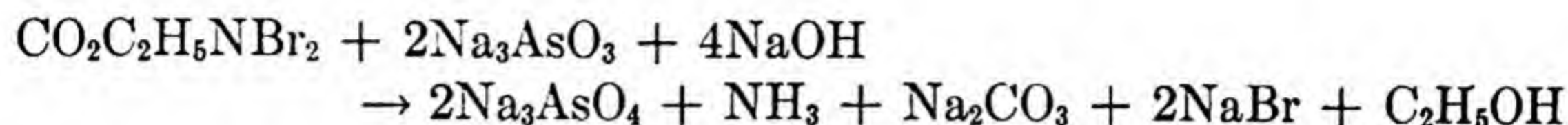
A. Gutmann, Z. anal. Chem., **66**, 224 (1925)

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I-1866

Dibromourethane will react with sodium arsenite in the presence of NaOH yielding sodium arsenate.



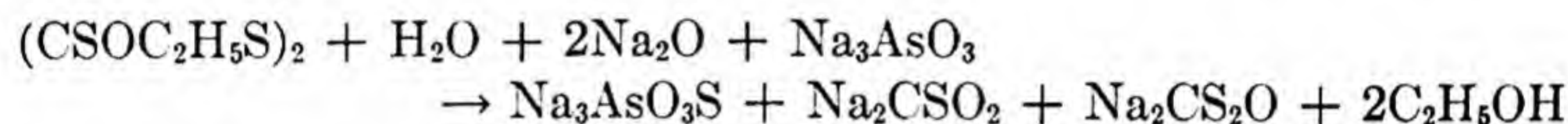
A. Gutmann, Z. anal. Chem., **65**, 250 (1924)

28



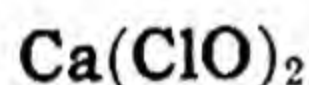
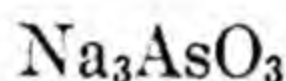
I-1867

Dixanthogen dissolved in alcohol reacts with sodium arsenite and Na₂O yielding sodium monothioarsenate.



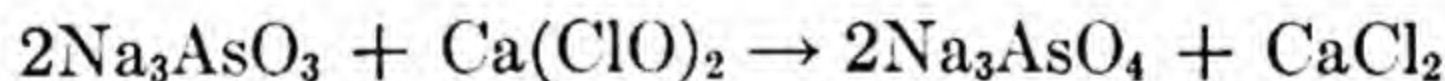
A. Gutmann, Z. anal. Chem., **66**, 224 (1925)

28



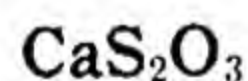
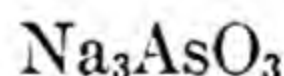
I-1868

In a solution containing sodium hydrogen carbonate and potassium bromide, sodium arsenite is oxidized by calcium hypochlorite. The mechanism of the reaction apparently depends upon the interaction of the hypochlorite and the bromide to form hypobromite which does the actual oxidizing.



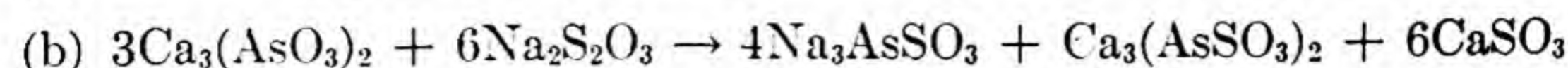
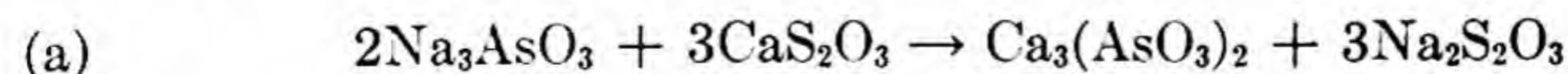
Kolthoff and Stenger, Ind. Eng. Chem., Anal. Ed., **7**, 80 (1935)

33



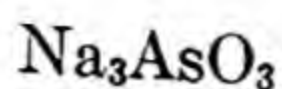
I-1869

Sodium monothioarsenate and calcium monothioarsenate are formed when a solution of sodium arsenite reacts with calcium thiosulfate.



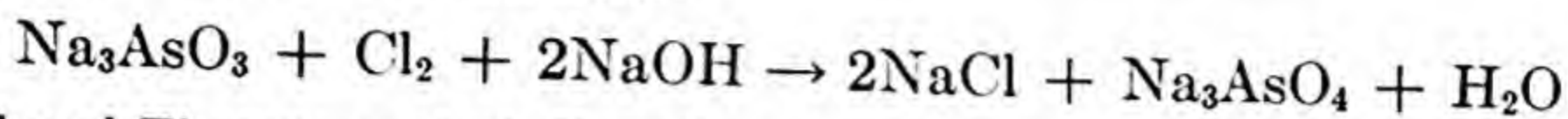
R. F. Weinland and A. Gutmann, Z. anorg. Chem., **17**, 409 (1898)

28



I-1870

On absorption in sodium arsenite and sodium hydroxide chlorine in solution is reduced to chloride.



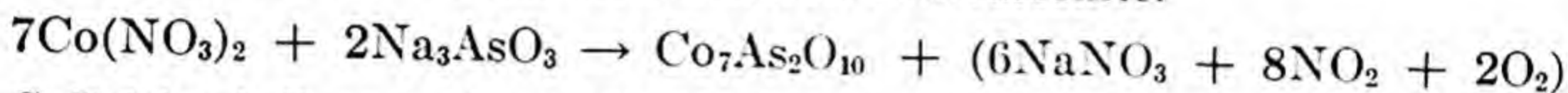
Willard and Thompson, *Ind. Eng. Chem., Anal. Ed.*, **2**, 272 (1930)

33



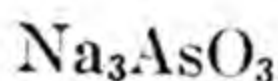
I-1871

Cobaltous nitrate reacts with sodium orthoarsenite.



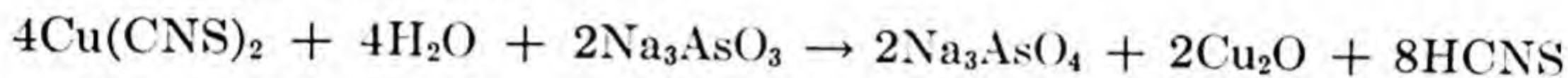
C. Reichard, *Z. anal. Chem.*, **42**, 110 (1903)

28



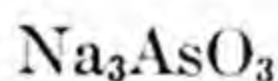
I-1872

Copper thiocyanate will react with sodium arsenite yielding sodium arsenate and thiocyanic acid.



A. Gutmann, *Z. anal. Chem.*, **66**, 224 (1925)

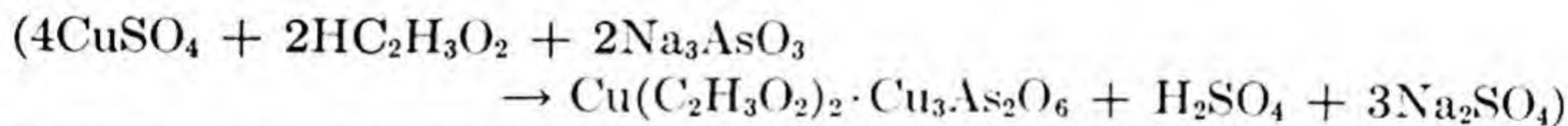
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I-1873

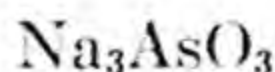


Paris green (copper aceto-arsenite) is prepared by adding sodium arsenite and sodium acetate to a solution of copper sulfate in acetic acid.



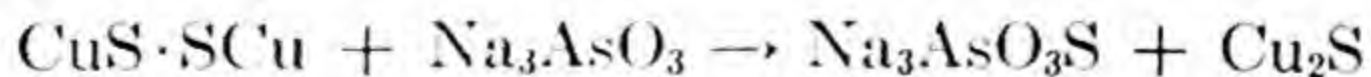
C. W. Drury and C. W. Simmons, *Can. Chem. Met. Eng.*, **9**, 181 (1925)

15



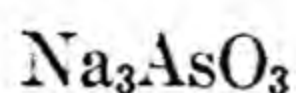
I-1874

Dicopper disulfide reacts with sodium arsenite yielding sodium monothioarsenate.

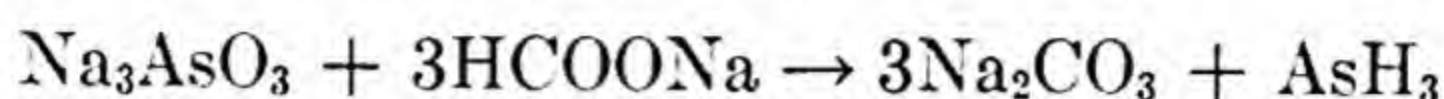


A. Gutmann, *Z. anal. Chem.*, **66**, 224 (1925)

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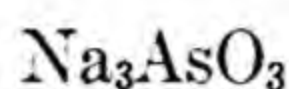
**HCOONa****I-1875**

Arsine is made by heating a mixture containing equal quantities of amorphous sodium arsenite and sodium formate.

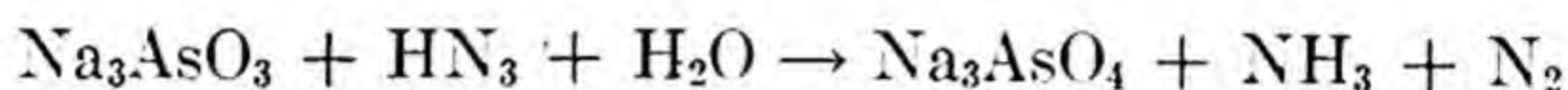


Vournasos, Ber., **43**, 2264 (1910)

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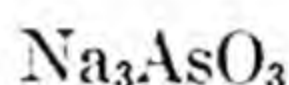
**HN₃****I-1876**

Sodium arsenate is formed when triazoic acid is boiled with a solution of sodium arsenite.

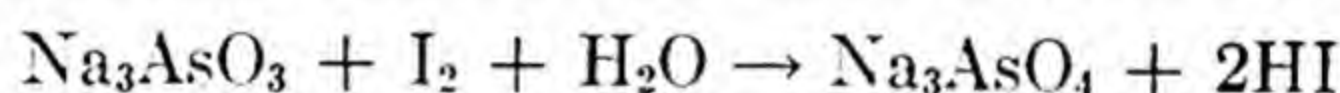


A. Gutmann: Ber., **45**, 830 (1912)

25

**I₂****I-1877****H₂O**

Iodine converts sodium orthoarsenite into sodium orthoarsenate.

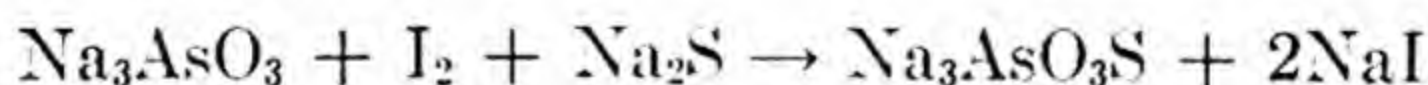


G. Bressanin, Ann. Chim. Anal., **17**, 81 (1912)

76

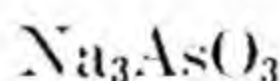
**I₂****Na₂S****I-1878**

Sodium monothioarsenate is formed when sodium arsenite reacts with iodine and sodium sulfide.

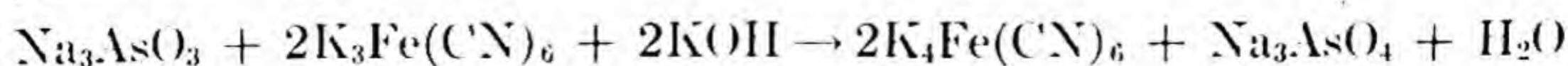


Weinland and Rumpf, Z. anorg. Chem., **14**, 42 (1897)

25

**K₃Fe(CN)₆****I-1879****KOH**

Sodium arsenite is oxidized by potassium ferricyanide in the presence of potassium hydroxide.

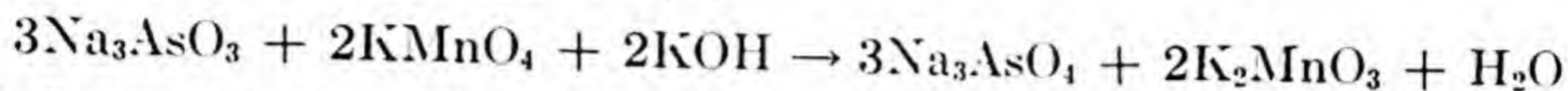


A. Gutmann: Ber., **42**, 3623 (1909)

25

KMnO₄Na₃AsO₃**KOH****I-1880**

Sodium arsenate is obtained when sodium arsenite reacts with potassium permanganate in alkaline solution.

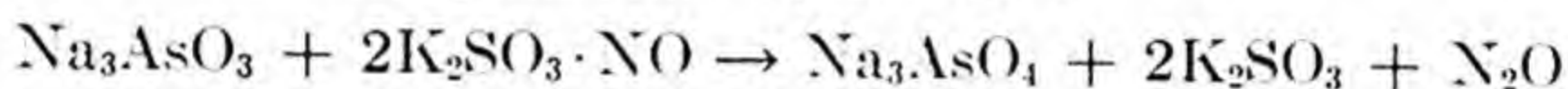


B. Brauner, Z. anal. Chem., **55**, 225 (1916)

28

Na₃AsO₃**K₂SO₃·NO****I-1881**

Sodium arsenate crystallizes out when a solution of nitric oxide-potassium sulfite is treated with an excess of sodium arsenite, and cooled. (N.B. Nitric oxide potassium sulfite is made by passing nitric oxide into a freshly prepared solution of potassium sulfite, which has been made strongly alkaline with potassium hydroxide.)

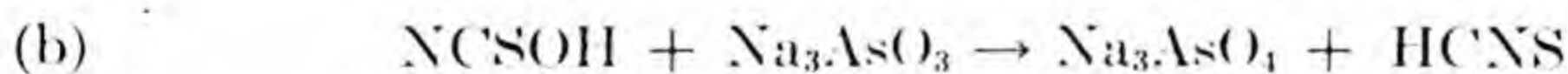
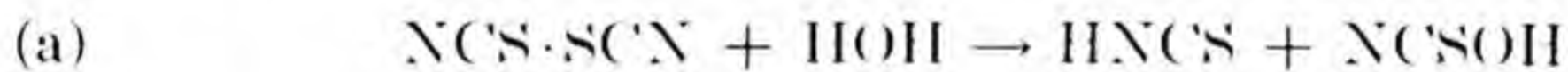


A. Gutmann, Ber., **55**, 3007 (1922)

25

Na₃AsO₃**NCS·SCN****I-1882****H₂O**

Dicyanogen sulfide, dissolved in ether, will react with sodium arsenite yielding sodium arsenate.

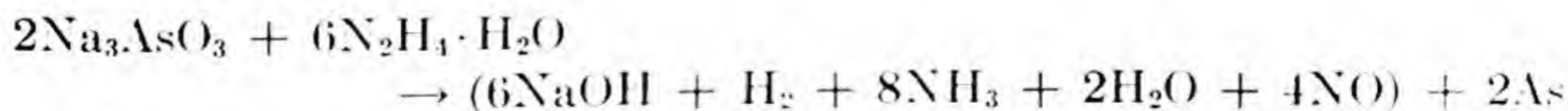


A. Gutmann, Z. anal. Chem., **66**, 224 (1925)

28

Na₃AsO₃**N₂H₄·H₂O****I-1883**

Arsenic separates when a water solution of sodium arsenite is treated with hydrazine hydrate.

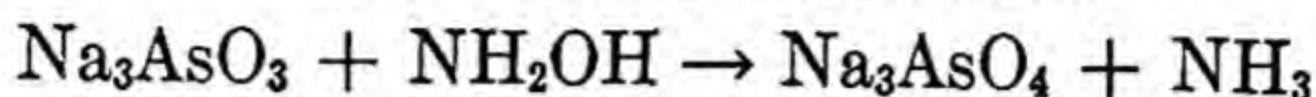


V. Kohlshutter, Ann., **400**, 268 (1913)

1

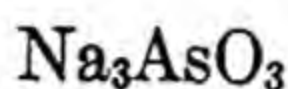
**NH₂OH****I-1884**

Sodium arsenate is formed and ammonia evolved when sodium arsenite is warmed on the water bath with hydroxylamine.

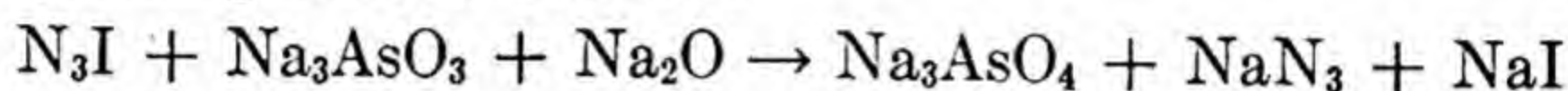


A. Gutmann, *Ber.*, **55**, 3007 (1922)

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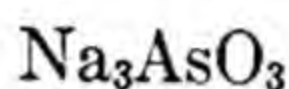
**N₃I****I-1885**

Iodine triazide in the presence of sodium oxide will react with sodium arsenite yielding sodium arsenate.

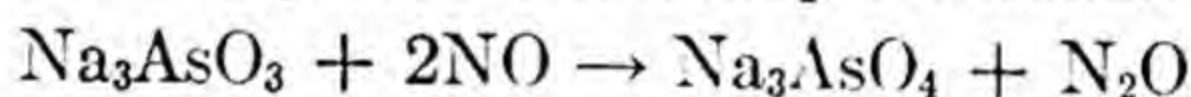


A. Gutmann, *Z. anal. Chem.*, **65**, 252 (1924)

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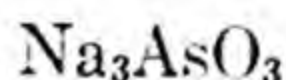
**NO****I-1886**

Sodium arsenate is obtained when a solution of sodium arsenite is oxidized by nitric oxide gas in the presence of a drop of alcohol.

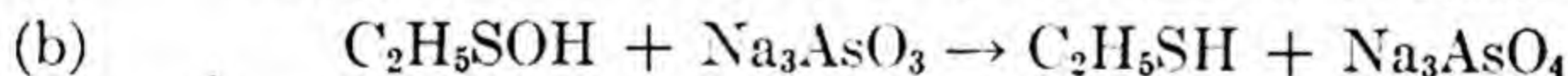
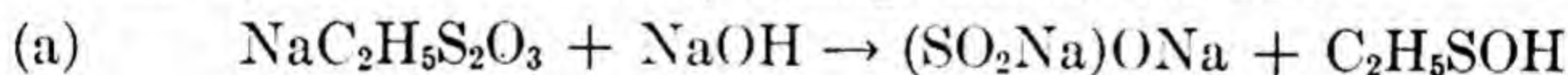


A. Gutmann: *Ber.*, **55**, 3007 (1922)

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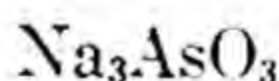
**NaC₂H₅S₂O₃****I-1887**

Sodium ethylthiosulfate will react with sodium arsenite in presence of sodium hydroxide solution yielding sodium arsenate.

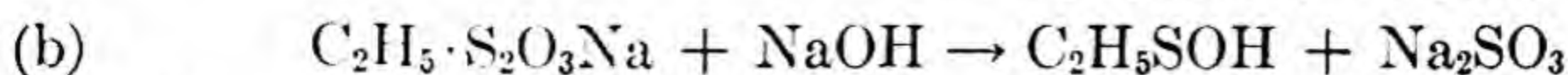
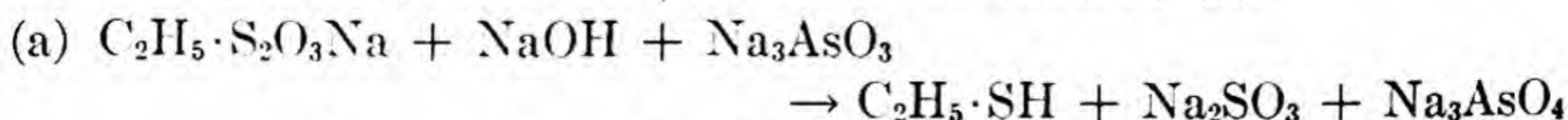


A. Gutmann, *Z. anal. Chem.*, **66**, 224 (1925)

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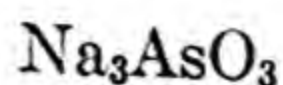
**Na₂C₂H₅S₂O₃****I-1888****NaOH**

Sodium ethylthiosulfate, sodium hydroxide and sodium arsenite react to form ethyl mercaptan, sodium sulfite and sodium arsenate, (a). The intermediate compound formed is thioethyl alcohol, (b).

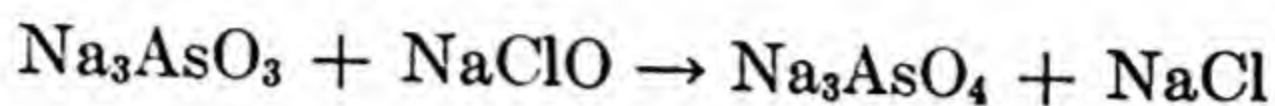


T. S. Price and D. F. Twiss, *J. Chem. Soc. (London)*, **93**, 1395 (1908)

102

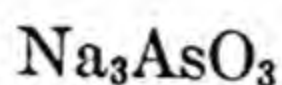
NaClO**I-1889**

Sodium hypochlorite reacts quantitatively with sodium arsenite oxidizing it to sodium arsenate.

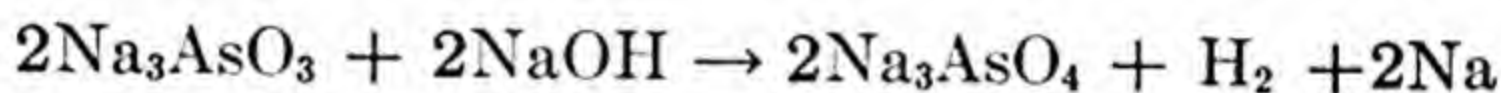


A. Gutmann, *Ber.*, **50**, 1717 (1917)

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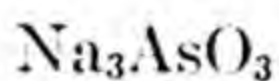
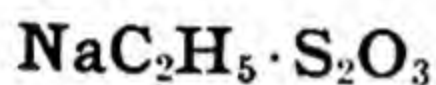
NaOH**I-1890**

Fusion at 300°C. of sodium hydroxide and sodium arsenite oxidizes the latter, as well as ferrous hydroxide, stannous hydroxide, vanadious and cerous hydroxide (but not sodium sulfite or sodium nitrite), with the evolution of the equivalent amount of hydrogen, the sodium hydroxide acting as a catalyst.

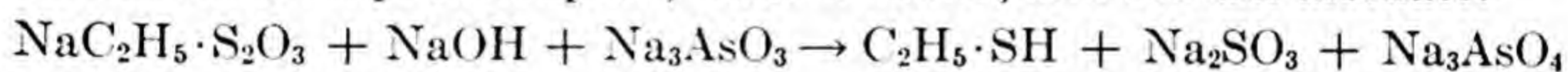


M. C. Boswell, *Can. Chem. Met. Eng.*, **10**, 139 (1926)

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NaOH**I-1891**

Sodium arsenite reacts with sodium ethylthiosulfate in alkaline solution to form ethyl mercaptan, sodium sulfite, and sodium arsenate.

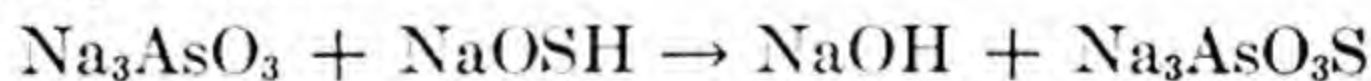


Price and Twiss, *J. Chem. Soc. (London)*, **93**, 1395 (1908)

103

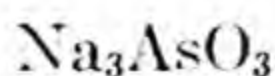
NaOSH**I-1892**

Sodium monothioarsenate is obtained when sodium arsenite reacts with sodium "hydropersulfide".



A. Gutmann, *Ber.*, **41**, 3354 (1908)

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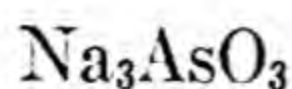
Na₂S₂**I-1893**

Sodium monothioarsenate is formed when sodium arsenite is treated with sodium disulfide.



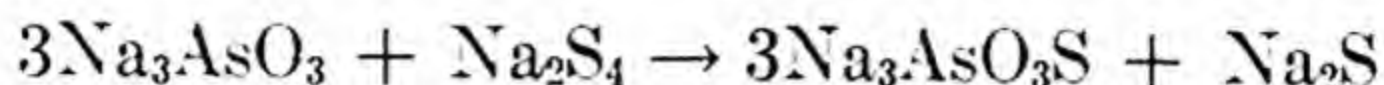
Weinland and Rumpf, *Z. anorg. Chem.*, **14**, 42 (1897)

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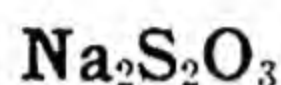
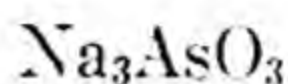
I-1894

Thin, colorless glossy needles of tertiary sodium monothioarsenate are made by boiling solutions of sodium polysulfide with sodium arsenite.



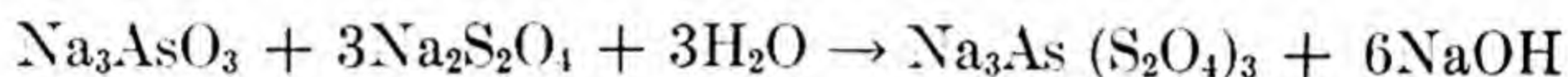
Weinland and Rumpf, *Z. anorg. Chem.*, **14**, 42 (1897)

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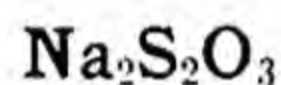
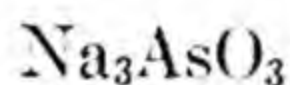
I-1895

Sodium arsenious hyposulfite is formed as a cream-white powder by agitating a mixture of 2.75 g. of sodium hyposulfite in a cold solution of 2.75 g. of sodium arsenate in 3 cc. of water.



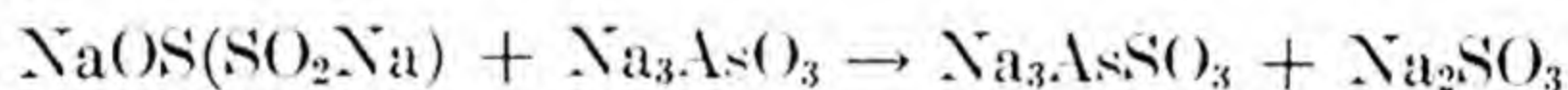
W. Farmer and J. B. Firth, *J. Chem. Soc. (London)*, **129**, 2019 (1927)

44



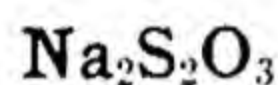
I-1896

Sodium thiosulfate reacts with sodium arsenite yielding trisodium monothioarsenate.



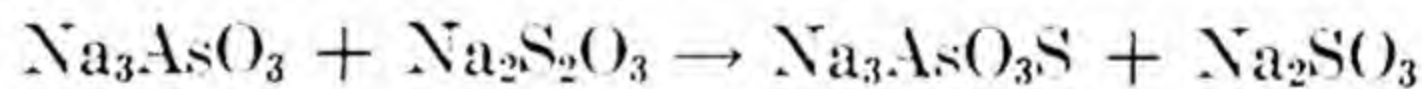
A. Gutmann, *Z. anal. Chem.*, **66**, 224 (1925)

28



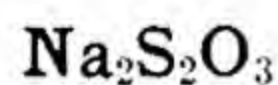
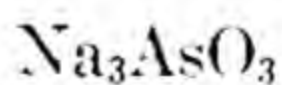
I-1897

Crystals are formed when a concentrated solution of sodium arsenite reacts with a concentrated solution of sodium thiosulfate.

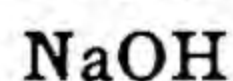


R. F. Weinland and A. Gutmann, *Z. anorg. Chem.*, **17**, 409 (1898)

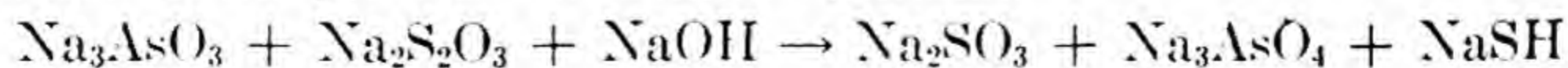
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I-1898



Sodium arsenate is formed when sodium thiosulfate reacts with sodium arsenite in the presence of sodium hydroxide.

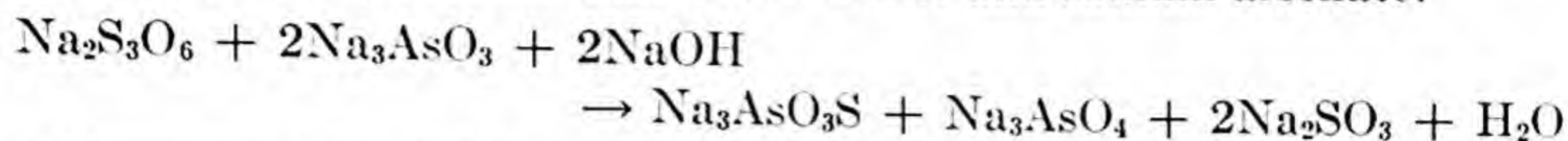


A. Gutmann: *Ber.*, **41**, 3351 (1908)

25

Na₂S₃O₆**Na₃AsO₃****I-1899**

Sodium trithionate will react with sodium arsenite in sodium hydroxide solution yielding sodium monothioarsenate and sodium arsenate.



A. Gutmann, Z. anal. Chem., **66**, 224 (1925)

28

Ref., T. S. Price and D. F. Twiss, J. Chem. Soc. (London), **91**, 2026 (1907)

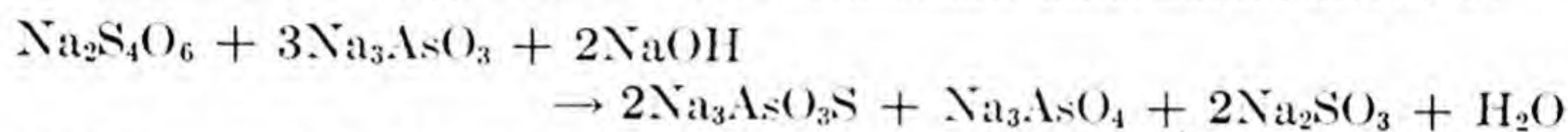
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Ref., A. Gutmann, Ber., **53**, 444 (1920)

25

Na₃AsO₃**Na₂S₄O₆****I-1900**

Sodium tetrathionate will react with sodium arsenite in sodium hydroxide solution yielding sodium monothioarsenate and sodium arsenate.



A. Gutmann, Ber., **53**, 444 (1920)

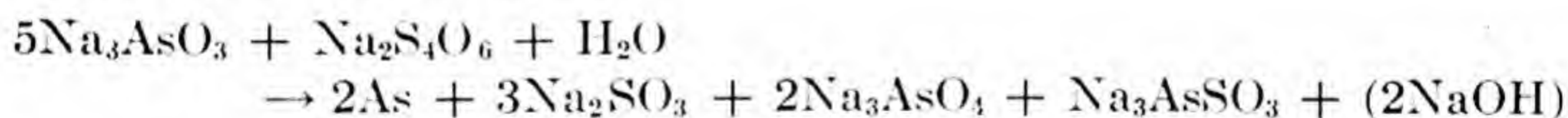
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Ref., A. Gutmann, Z. anal. Chem., **66**, 224 (1925)

28

Na₃AsO₃**Na₂S₄O₆****I-1901**

When a mixture of sodium arsenite and sodium tetrathionate is heated, elementary arsenic, sodium sulfite, sodium arsenate and sodium monothioarsenate are obtained.



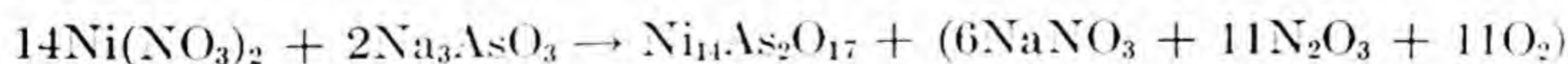
A. Gutmann, Ber., **55**, 3007 (1922)

Ref., A. Gutmann, *ibid.*, **57**, 1956 (1924)

25

Na₃AsO₃**Ni(NO₃)₂****I-1902**

Nickel nitrate reacts with sodium orthoarsenite.



C. Reichard, Z. anal. Chem., **42**, 110 (1903)

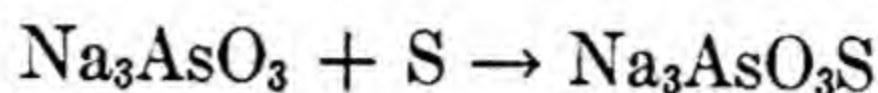
28



S

I-1903

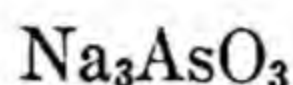
Beautiful colorless crystals of tertiary sodium monothioarsenate are prepared by boiling a concentrated solution of sodium arsenite with sulfur and then adding sulfur until no more will dissolve.



K. Preis, *Ann.*, **257**, 178 (1890)

Ref., Weinland and Rumpf, *Z. anorg. Chem.*, **14**, 42 (1897)

25

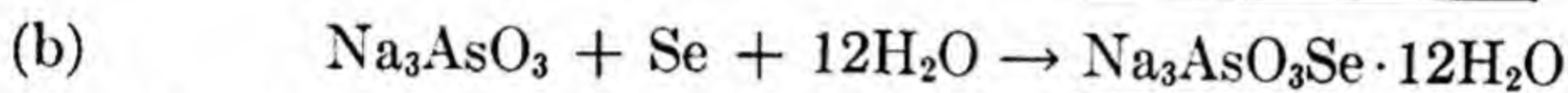
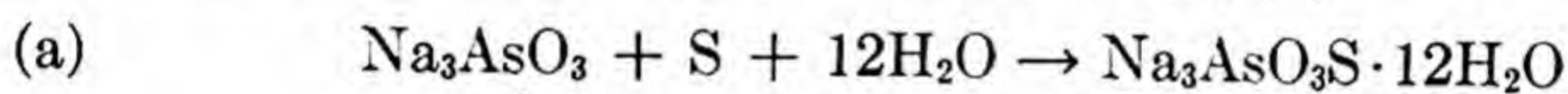


S

I-1904

Se

White crystals of dodecahydrated sodium monothioarsenate are obtained by heating a solution of sodium orthoarsenite with sulfur, (a). The same type reaction occurs with selenium, (b).



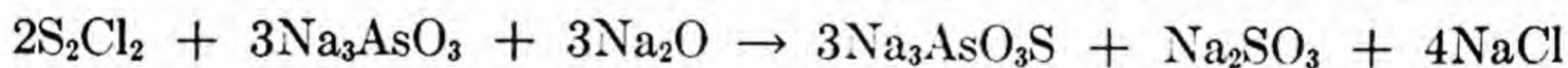
R. F. Weinland and O. Rumpf, *Z. anorg. Chem.*, **14**, 42 (1897)

28

S₂Cl₂

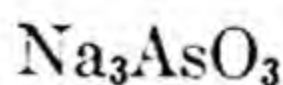
I-1905

A solution of sulfur monochloride in petroleum ether will react with sodium arsenite and sodium oxide yielding sodium monothioarsenate.



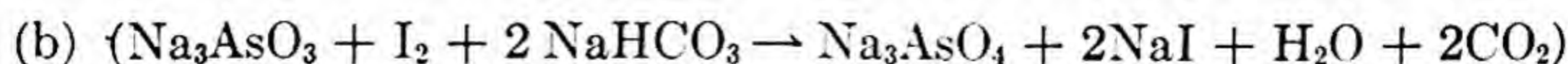
A. Gutmann, *Z. anal. Chem.*, **65**, 251 (1924)

28

TiCl₃

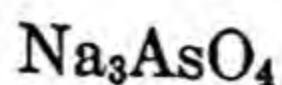
I-1906

Thallic salts react quantitatively with sodium arsenite. The salt is dissolved in dilute H₂SO₄, neutralized with sodium hydrogen carbonate, and an excess of Na₃AsO₃ added. The excess is titrated with standard iodine solution.

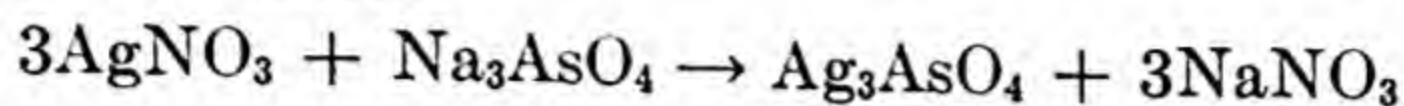


F. Čůta, *Coll. Czech. Chem. Comm.*, **5**, 287 (1933)

87

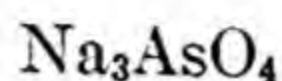
AgNO₃**I-1907**

Silver arsenate is precipitated when solutions of silver nitrate and sodium arsenate are mixed.

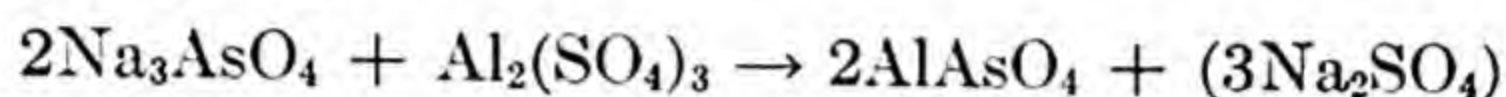


J. B. Moyer, J. Am. Chem. Soc., **18**, 1039 (1896)

1

**Al₂(SO₄)₃****I-1908**

Aluminum arsenate is formed when aluminum sulfate reacts with sodium arsenate at 200°.



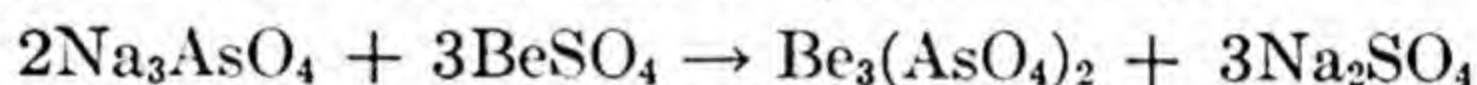
Coloriano, Compt. rend., **103**, 273

Ref., Ber., **19**, 660 (1886)

25

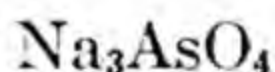
**BeSO₄****I-1909**

A loose white powdery compound called triberyllium arsenate is formed when sodium arsenate reacts with beryllium sulfate.

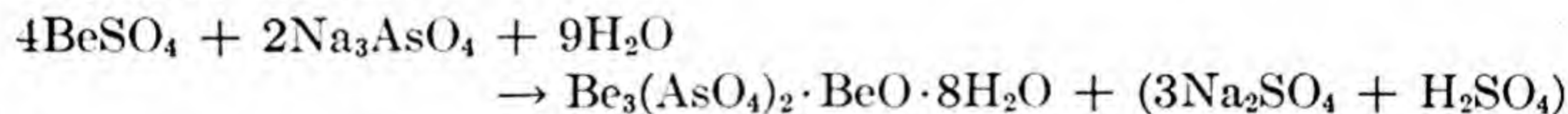


Bleyer and Müller: Z. anorg. Chem., **75**, 287 (1912)

25

**BeSO₄****I-1910**

Trisodium arsenate precipitates a monobasic salt of beryllium from beryllium sulfate.

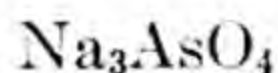


Bleyer and Müller, Z. anorg. Chem., **75**, 285 (1912)

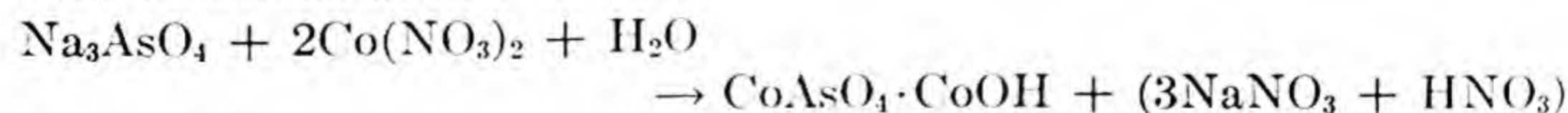
28

Ref., J. L. Howe, J. Am. Chem. Soc., **35**, 187 (1913)

1

**Co(NO₃)₂****I-1911**

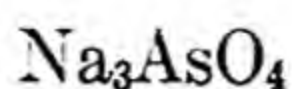
Orthorhombic, dark red prisms are formed when sodium arsenate reacts with cobaltous nitrate at 180°.



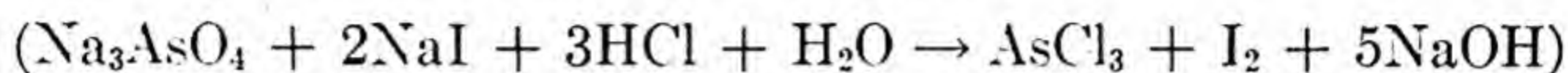
Coloriano: Compt. rend., **103**, 273

Ref., Ber., **19**, 660 (1886)

25

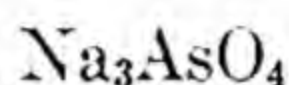
**HCl****I-1912****NaI**

If hydrochloric acid solution is added to a mixture of arsenate and iodide, arsenious chloride and iodine are produced.

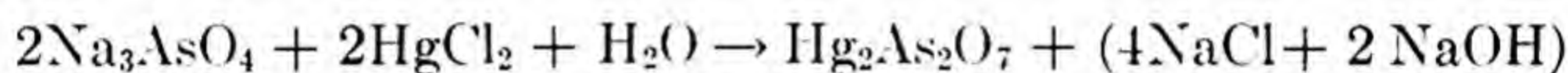


J. E. MacKenzie and H. Marshall, *J. Chem. Soc. (London)*, **93**, 1728 (1908)

57

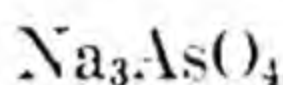
**HgCl₂****I-1913**

Mercuric pyroarsenate is formed when sodium arsenate reacts with mercuric chloride.

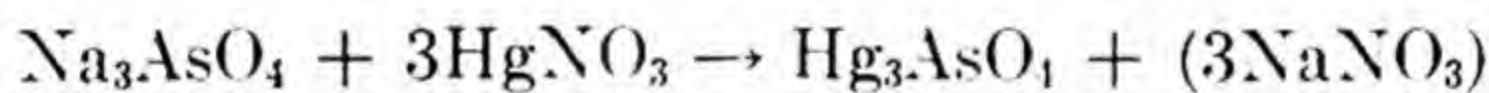


Bergmann, *Opuscula Physica et Chemica Upsala*, 1779 to 1784

25

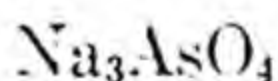
**HgNO₃****I-1914**

Mercurous arsenate is formed as an orange precipitate when mercurous nitrate is treated with an excess of sodium arsenate.

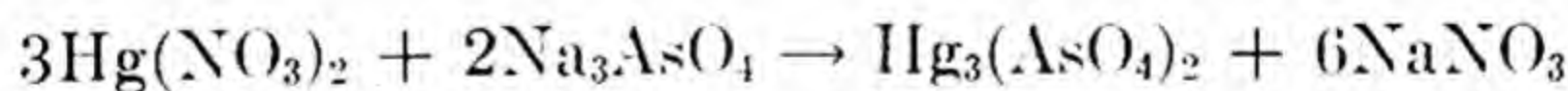


K. Haack: *Ann.* **262**, 190 (1891)

25

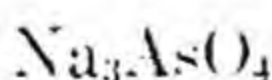
**Hg(NO₃)₂****I-1915**

Mercuric arsenate precipitates as a heavy yellowish-white precipitate when an excess of sodium arsenate is added to mercuric nitrate solution.

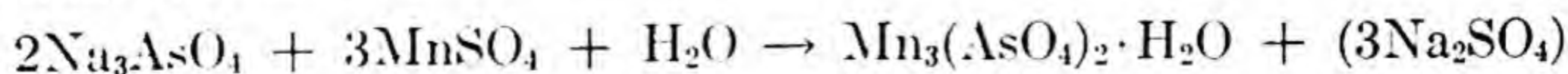


C. J. Pretzfeld, *J. Am. Chem. Soc.*, **25**, 202 (1903)

1

**MnSO₄****I-1916**

Manganous arsenate is formed when manganous sulfate reacts with sodium arsenate at 175°.



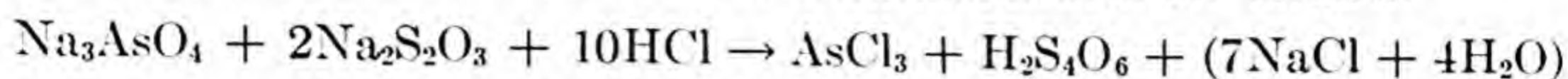
Coloriano, *Compt. rend.*, **103**, 273

Ref., E. Schleicher, *Ber.*, **19**, 660 (1886)

25

Na₂S₂O₃Na₃AsO₄**I-1917****HCl**

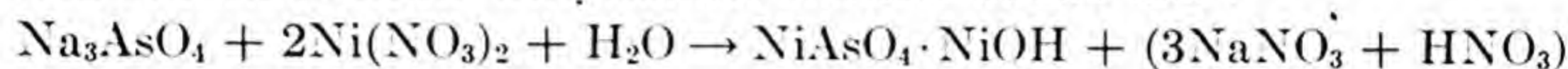
When hydrochloric acid solution is added to a mixture of arsenate and thiosulfate, arsenic trichloride and tetrathionic acid are formed.



J. E. MacKenzie and H. Marshall, J. Chem. Soc., (London), **93**, 1728 (1908) 57

Na₃AsO₄**Ni(NO₃)₂****I-1918**

Bright green hexagonal crystals are obtained by treating a dilute solution of nickel nitrate with sodium arsenate at 235–260°.

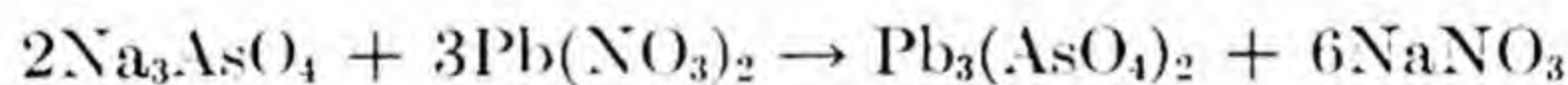


Coloriano, Compt. rend., **103**, 273

Ref., E. Schleicher, Ber., **19**, 660 (1886) 25

Na₃AsO₄**Pb(NO₃)₂****I-1919**

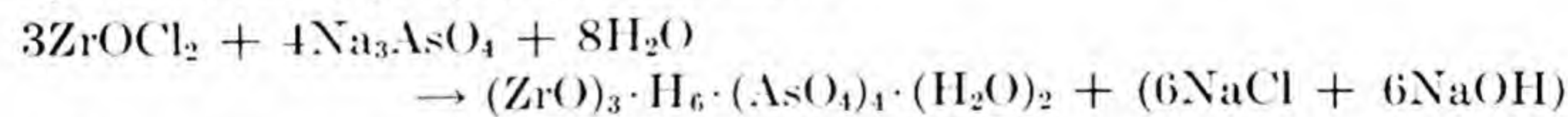
Lead arsenate is precipitated when a diluted solution of lead nitrate is titrated in the cold with 0.1*N* sodium arsenate in the presence of methyl red.



Jellinek and Kühn: Z. anorg. Chem., **138**, 123 (1925) 25

Na₃AsO₄**ZrOCl₂****I-1920**

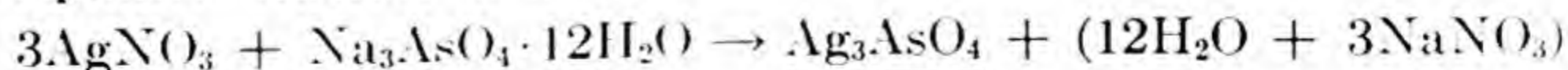
Sodium arsenate and zirconyl chloride precipitate white, voluminous hydrated zirconyl hydrogen arsenate.



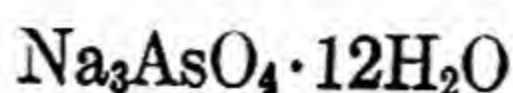
L. F. Nilson, Nova Act. Reg. Soc. Sci. Upsal., Series 3, **9**, No. 5, 52 (1874) 10

Na₃AsO₄ · 12H₂O**AgNO₃****I-1921**

The addition of silver nitrate to hydrated trisodium arsenate in solution precipitates trisilver arsenate.



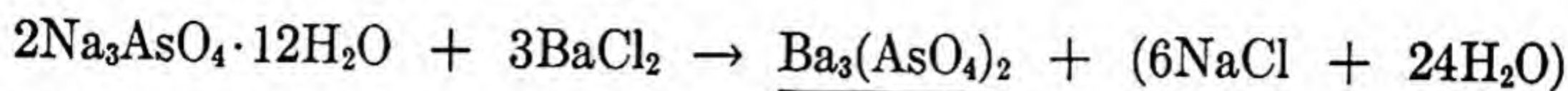
Thomas Graham, Trans. Roy. Soc. (London), **123**, 253 (1833) 105



BaCl₂

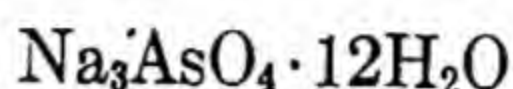
I-1922

Barium chloride in slight excess added to a solution of trisodium arsenate precipitates barium arsenate.



Thomas Graham, Trans. Roy. Soc. (London), **123**, 264 (1833)

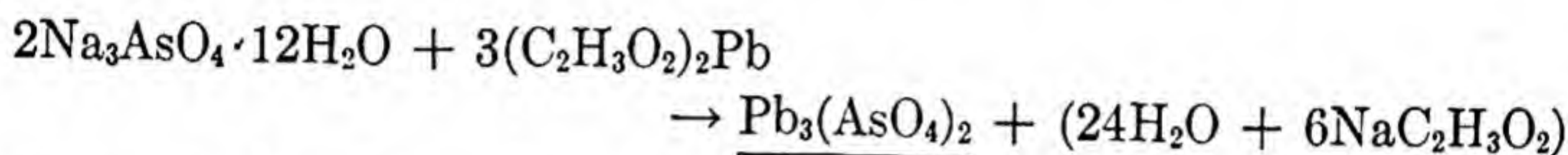
105



(C₂H₃O₂)₂Pb

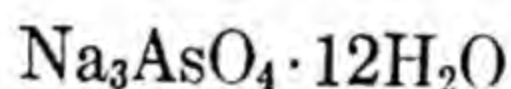
I-1923

Lead acetate precipitates lead arsenate from a solution of trisodium arsenate.



Thomas Graham, Trans. Roy. Soc., (London), **123**, 259 (1833)

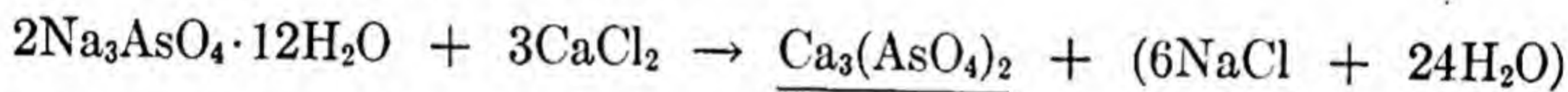
105



CaCl₂

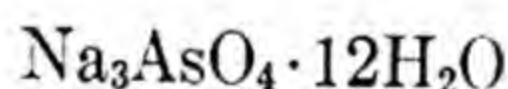
I-1924

The addition of calcium chloride to a solution of trisodium arsenate precipitates calcium arsenate.



Thomas Graham, Trans. Roy. Soc. (London), **123**, 265 (1833)

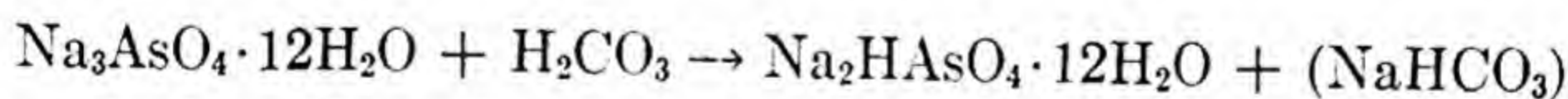
105



H₂CO₃

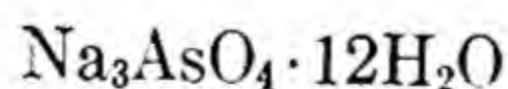
I-1925

The addition of carbonic acid to hydrated trisodium arsenate gives the disodium salt.



Thomas Graham, Trans. Roy. Soc. (London), **123**, 255 (1833)

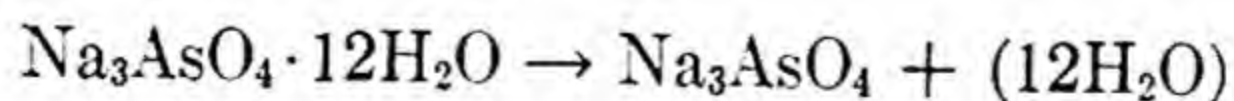
105



Δ

I-1926

Hydrated trisodium arsenate when heated loses 49.8% of its weight as water but 0.5% is still left.



Thomas Graham, Trans. Roy. Soc., (London), **123**, 256 (1833)

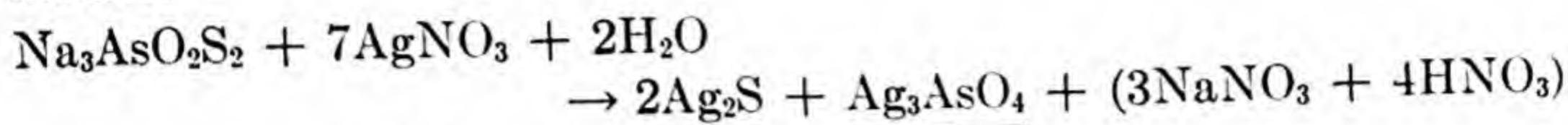
105



I-1927

AgNO₃

A black precipitate of silver sulfide and reddish brown silver arsenate is formed when sodium dithioarsenate is treated with an excess of silver nitrate.

K. Preis: Ann., **257**, 185 (1890)

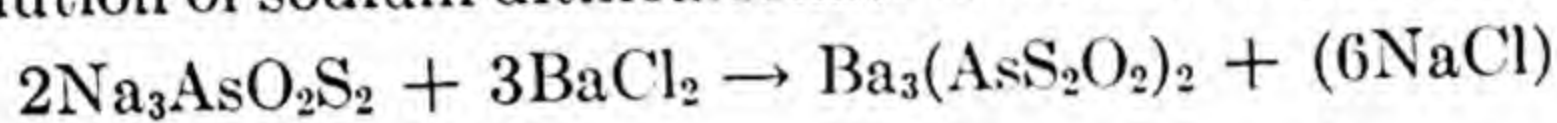
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I-1928

BaCl₂

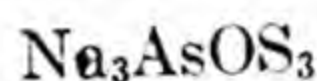
A curdy, crystalline precipitate of barium dithioarsenate is formed when a solution of sodium dithioarsenate is treated with barium chloride.

K. Preis, Ann., **257**, 185 (1890)

25

Ref., McCay and Foster, J. Am. Chem. Soc., **26**, 307 (1904)

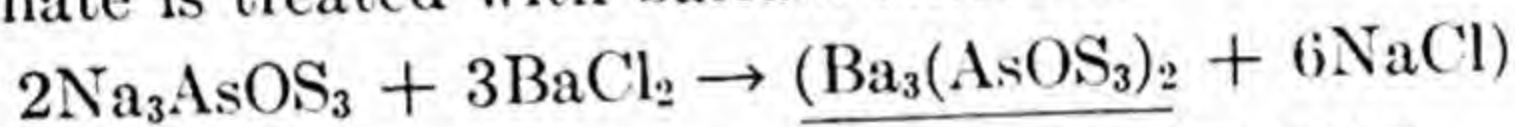
1



I-1929

BaCl₂

Barium trithioarsenate precipitates slowly when a solution of sodium trithioarsenate is treated with barium chloride.

L. W. McCay and W. Foster, J. Am. Chem. Soc., **26**, 307 (1904)

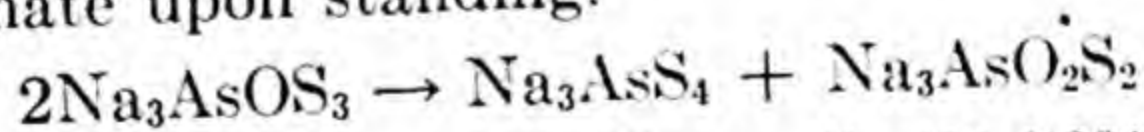
1



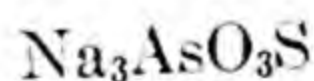
I-1930

Decomp.

Sodium trithioarsenate decomposes into sodium thioarsenate and sodium dithioarsenate upon standing.

L. W. McCay and W. Foster, Z. anorg. Chem., **41**, 452 (1904)

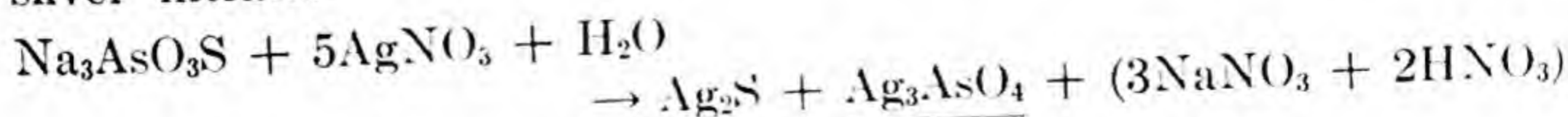
25



I-1931

AgNO₃

A black precipitate of silver sulfide and red-brown silver arsenate is formed when sodium monothioarsenate is treated with an excess of silver nitrate.

K. Preis: Ann., **257**, 181, (1890)

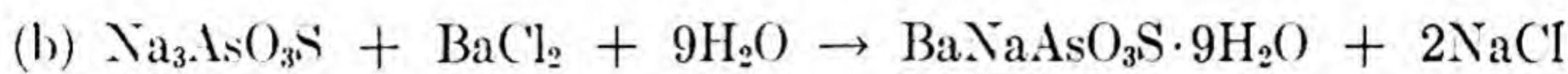
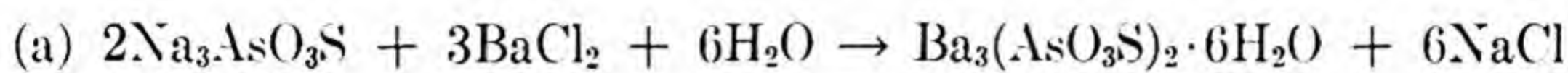
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$\text{Na}_3\text{AsO}_3\text{S}$

BaCl_2

I-1932

A solution of sodium thioarsenate will react with a solution of barium chloride yielding white crystals of barium thioarsenate. In very diluted solutions barium sodium thioarsenate is formed.



R. F. Weinland and O. Rumpf, *Z. anorg. Chem.*, **14**, 42 (1897)

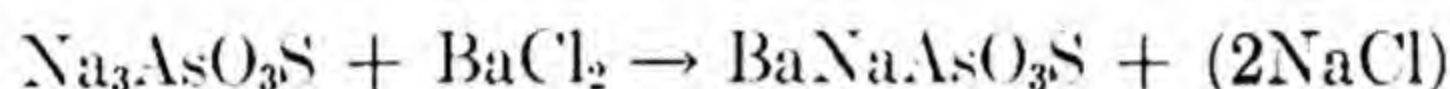
28

$\text{Na}_3\text{AsO}_3\text{S}$

BaCl_2

I-1933

An amorphous precipitate of sodium barium monothioarsenate is formed when a solution of sodium monothioarsenate is treated with barium chloride.



Weinland and Rumpf: *Z. anorg. Chem.*, **14**, 42 (1897)

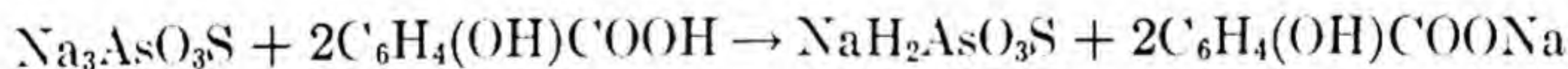
25

$\text{Na}_3\text{AsO}_3\text{S}$

$\text{C}_6\text{H}_4(\text{OH}) \cdot \text{COOH}$

I-1934

Sodium thioarsenate and salicylic acid are rubbed together. Then alcohol is added. Insoluble sodium dihydrogen thioarsenate is obtained. A similar reaction occurs when potassium thioarsenate is used.



R. F. Weinland and O. Rumpf, *Z. anorg. Chem.*, **14**, 42 (1897)

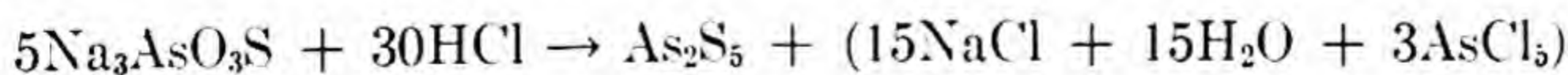
28

$\text{Na}_3\text{AsO}_3\text{S}$

HCl

I-1935

A pale yellow precipitate of arsenic pentasulfide is formed when trisodium monothioarsenate is treated with dilute hydrochloric acid.

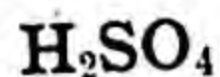


K. Preis, *Ann.*, **257**, 181 (1890)

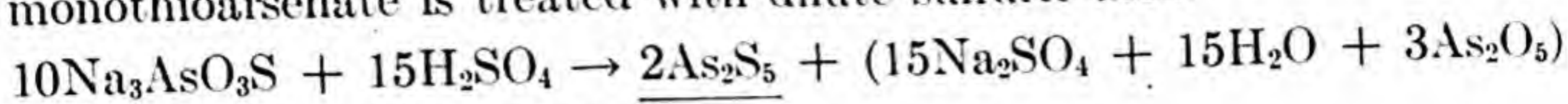
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I-1936



A pale yellow precipitate of arsenic pentasulfide is formed when sodium monothioarsenate is treated with dilute sulfuric acid.



K. Preis, *Ann.*, **257**, 181 (1890)

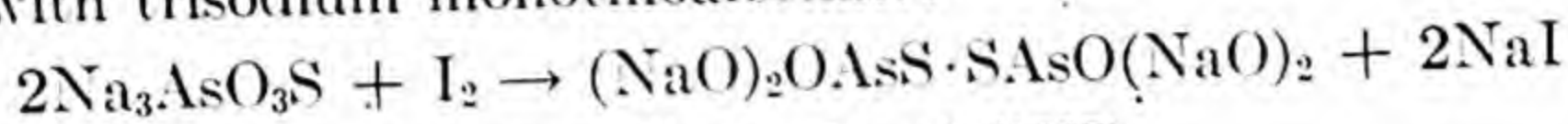
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I-1937

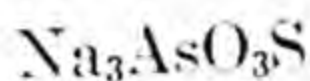


A compound (similar to sodium tetrathionate) is formed when iodine reacts with trisodium monothioarsenate.



Weinland and Rumpf, *Z. anorg. Chem.*, **14**, 42 (1897)

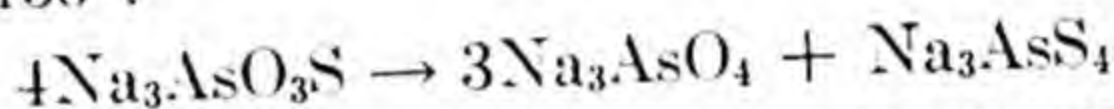
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I-1938

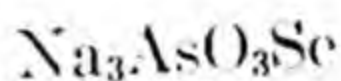


Sodium thioarsenate is decomposed when heated in a sealed tube at a temperature of 150°.



R. F. Weinland and O. Rumpf, *Z. anorg. Chem.*, **14**, 42 (1897)

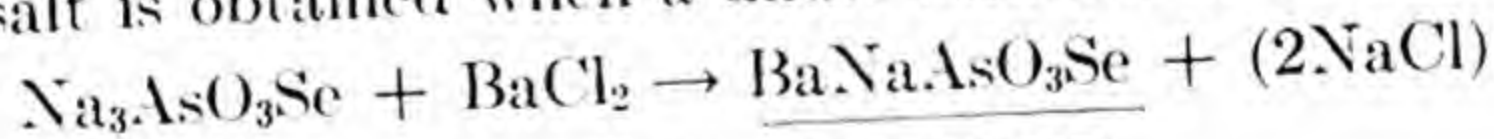
28



I-1939

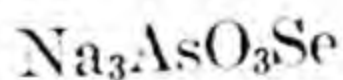


Sodium barium monoselenoarsenate is formed when a solution of sodium monoselenoarsenate is treated with barium chloride. The monohydrated salt is obtained when a dilute solution of BaCl_2 is used.



Weinland and Rumpf, *Z. anorg. Chem.*, **14**, 42 (1897)

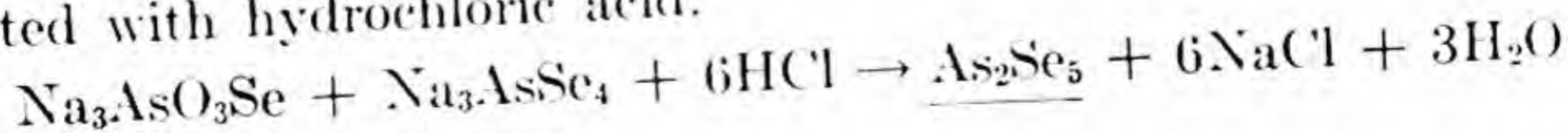
28



I-1940

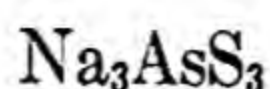


Arsenic pentaselenide is precipitated when a solution containing a mixture of sodium monoselenoarsenate and sodium selenoarsenate is treated with hydrochloric acid.



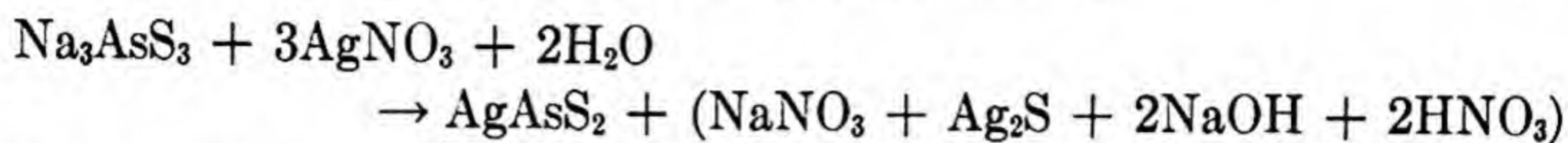
Szarvasy, *Ber.*, **28**, 2654 (1895)

25



I-1941

Yellowish-brown silver metathioarsenite is precipitated when sodium thioarsenite solution is treated with silver nitrate.



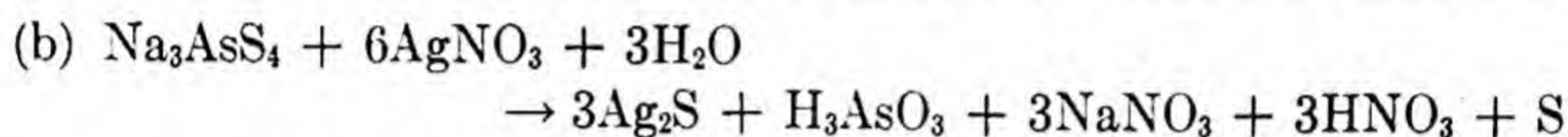
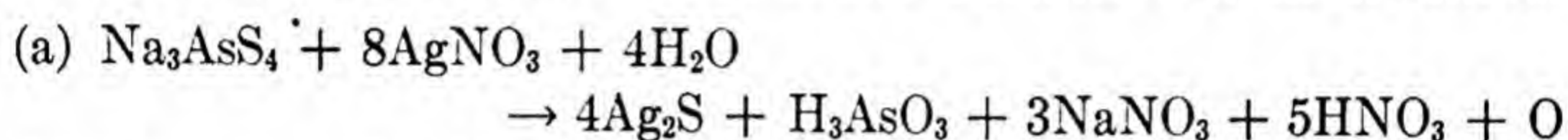
Berzelius, Pogg. Ann., **27**, 159

25



I-1942

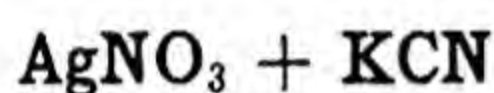
Silver sulfide and arsenious acid are obtained when a neutral or ammoniacal solution of sodium thioarsenate is treated with silver nitrate.



B. Rayman: Bull. Soc. Chim., **47**, 892

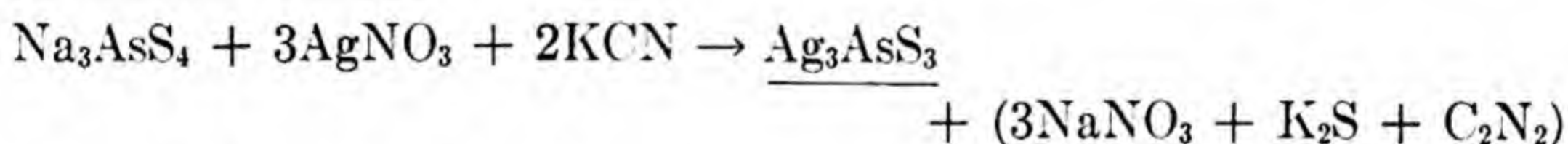
Ref., Ber., **20**, 684 (1887)

31



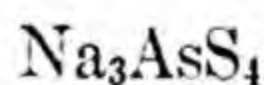
I-1943

A red crystalline precipitate of silver thioarsenite is formed when sodium thioarsenate solution is precipitated with silver nitrate in the presence of potassium cyanide.



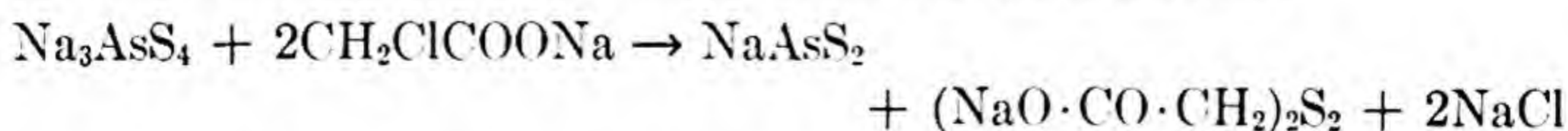
K. Preis, Ann., **257**, 199 (1890)

1



I-1944

A solution of sodium thioarsenate will react with the sodium salt of monochloroacetic acid yielding sodium metathioarsenite.

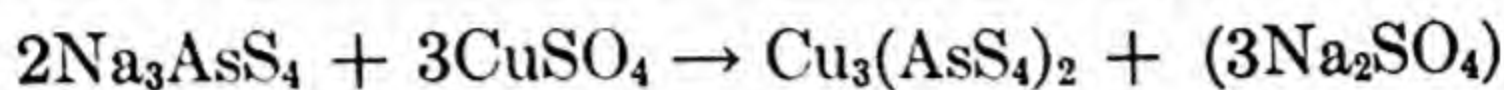


B. Holmberg, Z. anorg. Chem., **56**, 385 (1908)

28

CuSO₄**Na₃AsS₄****I-1945**

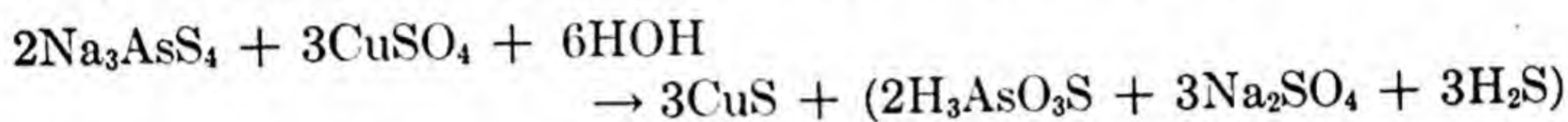
A reddish brown precipitate of cupric thioarsenate is formed when a solution of sodium thioarsenate is treated with copper sulfate solution.

K. Preis, Ann., **257**, 201 (1890)

1

Na₃AsS₄**CuSO₄****I-1946**

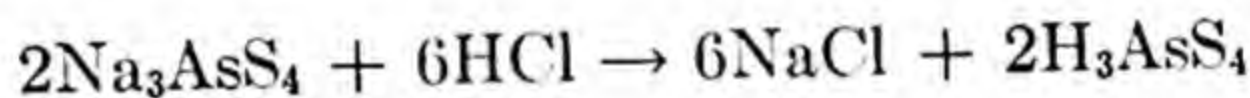
A black precipitate of copper sulfide forms when an excess of copper sulfate is boiled with a solution of sodium thioarsenate.

K. Preis, Ann., **257**, 201 (1890)

1

Na₃AsS₄**HCl****I-1947**

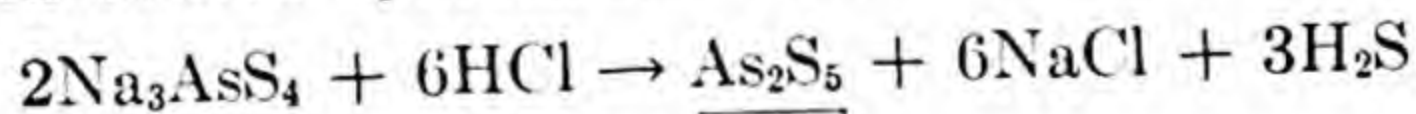
Thioarsenic acid is formed when hydrochloric acid decomposes sodium thioarsenate.

Nilson, J. Prakt. Chem., **14**, 149; *ibid.* **19**, 170Ref., F. Krafft and A. Kraschau, Ber., **29**, 433 (1896)

25

Na₃AsS₄**HCl****I-1948**

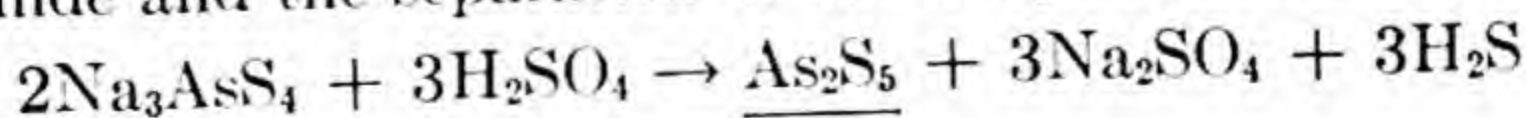
Arsenic pentasulfide is obtained by the decomposition of sodium thioarsenate with diluted hydrochloric acid.

A. Fuchs, Z. anal. Chem., **1**, 189 (1862)

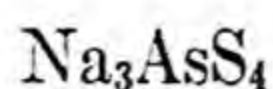
28

Na₃AsS₄**H₂SO₄****I-1949**

Sulfuric acid reacts with sodium thioarsenate with the evolution of hydrogen sulfide and the separation of arsenic pentasulfide.

L. McCay: Z. anal. Chem., **31**, 372 (1892)

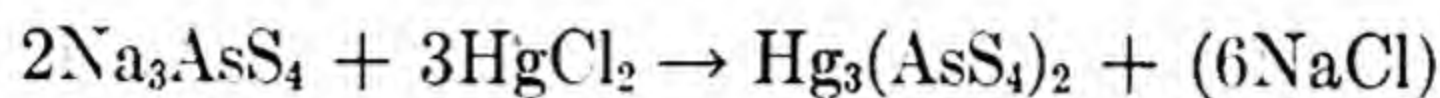
25



HgCl₂

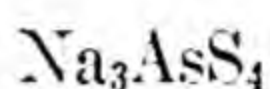
I-1950

An orange-yellow precipitate of mercuric thioarsenate is formed when a solution of sodium thioarsenate is treated with a solution containing an equivalent amount of mercuric chloride.



K. Preis, Ann., **257**, 200 (1890)

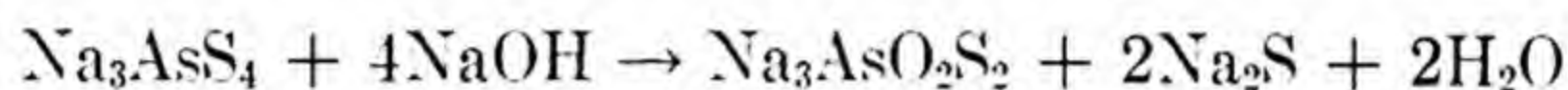
1



NaOH

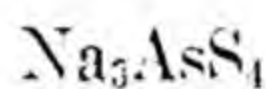
I-1951

Sodium dithioarsenate is formed when a solution of sodium thioarsenate is heated with a sufficient amount of sodium hydroxide.



K. Preis: Ann., **257**, 184 (1890)

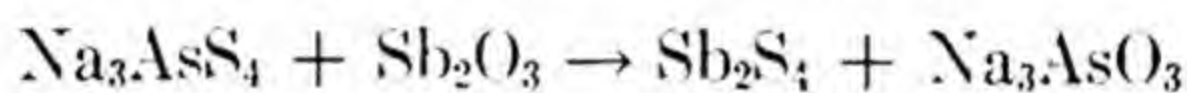
25



Sb₂O₃

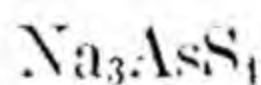
I-1952

Sodium thioarsenate will react with antimony trioxide yielding a precipitate of orange-red color, antimony tetrasulfide.



R. F. Weinland and P. Lehmann, Z. anorg. Chem., **26**, 322 (1901)

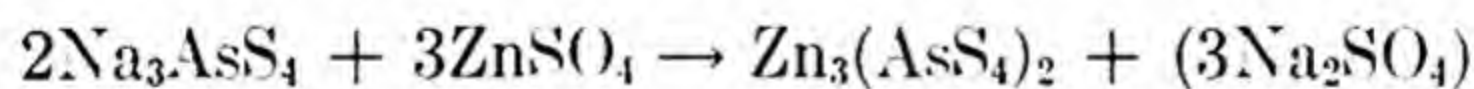
28



ZnSO₄

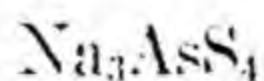
I-1953

A voluminous light yellow precipitate of zinc thioarsenate forms when cold solutions of sodium thioarsenate and zinc sulfate are mixed.



K. Preis, Ann., **257**, 202 (1890)

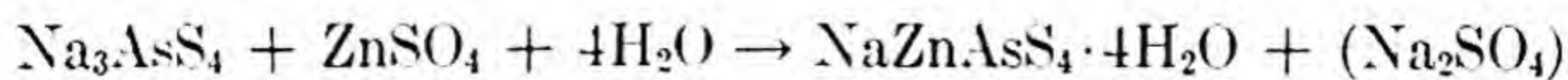
1



ZnSO₄

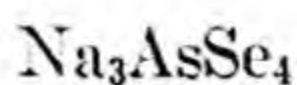
I-1954

Sodium zinc thioarsenate forms as a yellow, crystalline precipitate when a dilute solution of zinc sulfate is poured into a concentrated solution of sodium thioarsenate.



K. Preis, Ann., **257**, 202 (1890)

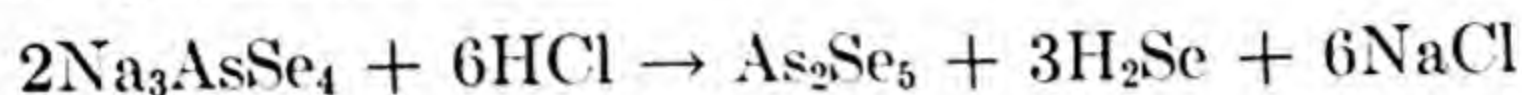
25



HCl

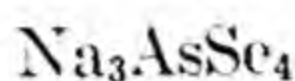
I-1955

Arsenic pentaselenide is prepared by decomposing sodium selenoarsenate with hydrochloric acid.



Szarvasy: Ber., **28**, 2654 (1895)

25

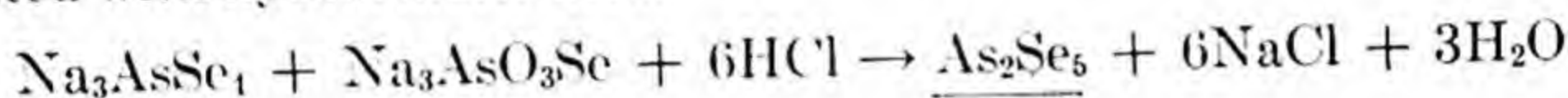


$$\text{Na}_3\text{AsO}_3\text{Se}$$

I-1956

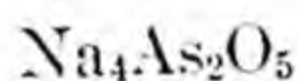
HCl

Arsenic pentaselenide is precipitated when a solution containing a mixture of sodium selenoarsenate and sodium monoselenoarsenate is treated with hydrochloric acid.



Szarvasy, Ber., **28**, 2654 (1895)

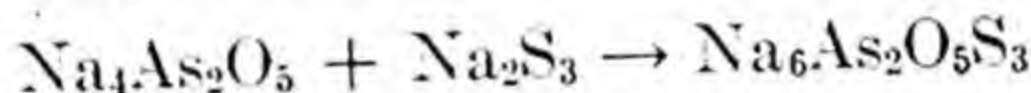
25



$$\text{Na}_2\text{S}_3$$

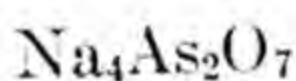
I-1957

A salt is formed when sodium trisulfide reacts with sodium pyroarsenite in concentrated ice-cold solution.



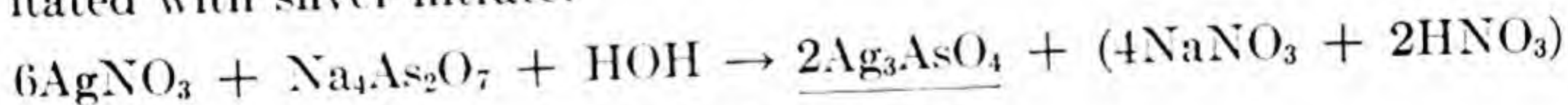
Weinland and Rumpf: Z. anorg. Chem., **14**, 42 (1897)

25

AgNO₃

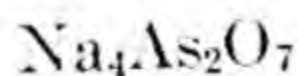
I-1958

Silver arsenate is formed when sodium pyroarsenate solution is precipitated with silver nitrate.



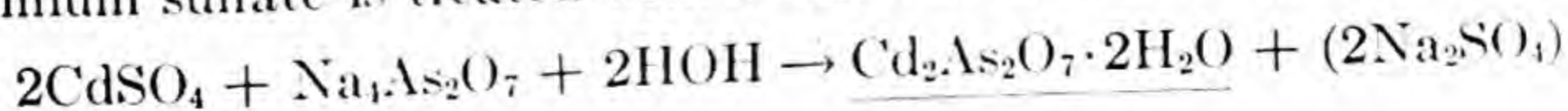
E. A. Atkinson, J. Am. Chem. Soc., **20**, 806 (1898)

1

CdSO₄

I-1959

A granular salt of cadmium pyroarsenate is precipitated when pure cadmium sulfate is treated with a solution of sodium pyroarsenate.



J. B. Moyer, J. Am. Chem. Soc., **18**, 1039 (1896)

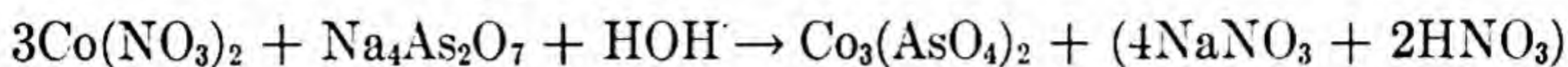
1

130
Co(NO₃)₂

Na₄As₂O₇

I-1960

Cobalt arsenate is precipitated when a solution of cobalt nitrate is treated with sodium pyroarsenate.



E. A. Atkinson, J. Am. Chem. Soc., **20**, 807 (1898)

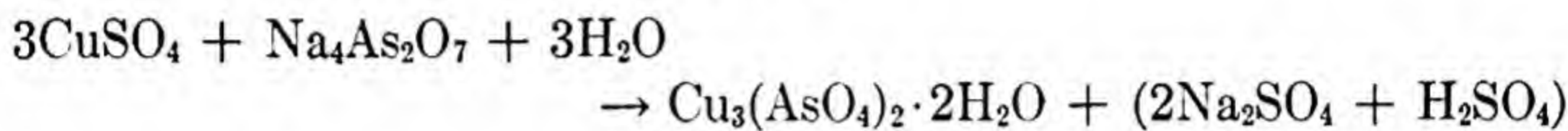
1

CuSO₄

Na₄As₂O₇

I-1961

A green copper arsenate is formed when a solution of pure copper sulfate is treated with sodium pyroarsenate.



J. B. Moyer, J. Am. Chem. Soc., **18**, 1038 (1896)

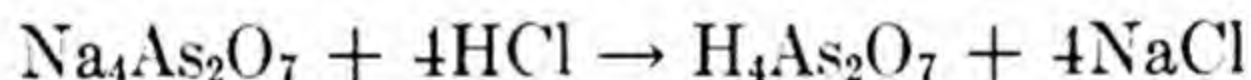
1

HCl

Na₄As₂O₇

I-1962

Sodium pyroarsenate is completely converted into the corresponding acid when heated in the presence of hydrogen chloride.



Smith and Hibbs, J. Am. Chem. Soc., **17**, 683 (1895)

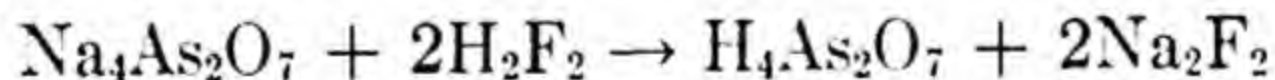
1

H₂F₂

Na₄As₂O₇

I-1963

Sodium pyroarsenate is partially converted into the corresponding acid when heated at 400° in a brisk current of hydrogen fluoride.



Smith and Meyer, J. Am. Chem. Soc., **17**, 736 (1895)

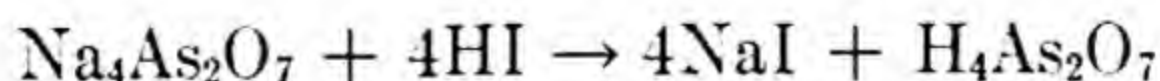
1

HI

Na₄As₂O₇

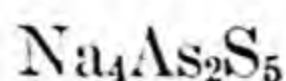
I-1964

Sodium pyroarsenate reacts with explosive violence when heated in hydrogen iodide.

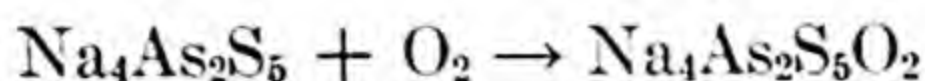


Smith and Meyer, J. Am. Chem. Soc., **17**, 739 (1895)

1

**O₂****I-1965**

Sodium pyroarsenite will absorb oxygen from the air if the pH is maintained at 7.5 or over.

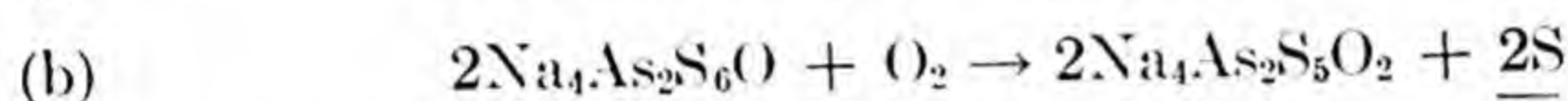
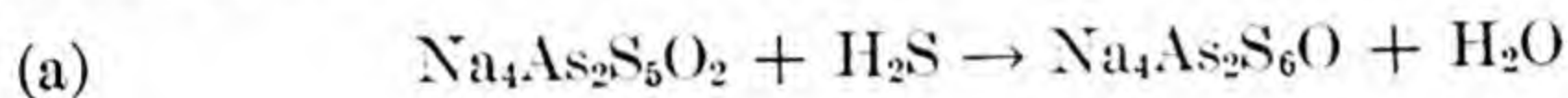


Gollmar, Ind. Eng. Chem., **26**, 131 (1934)

24

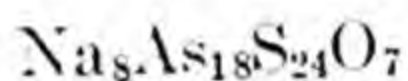
**H₂S****I-1966**

A complex sodium pyrothioarsenate absorbs hydrogen sulfide in the gaseous state with the formation of a compound of similar composition, which in turn is oxidized back again with free oxygen.

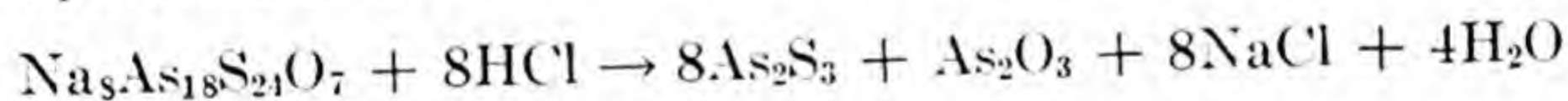


Gollmar, Ind. Eng. Chem., **26**, 131 (1934)

24

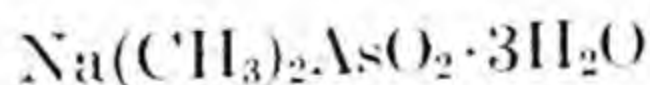
**HCl****I-1967**

This salt decomposes into arsenic trioxide and trisulfide when treated with hydrochloric acid.

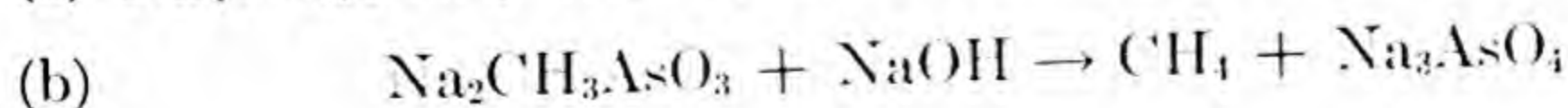
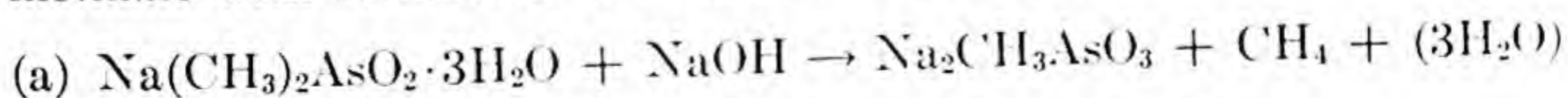


K. Preis, Ann., **257**, 195 (1890)

1

**NaOH****I-1968**

If sodium cacodylate is heated with sodium hydroxide to 180°, disodium methyl arsenite is formed with liberation of one molecule of methane (a). Raising the temperature to 260° liberates another molecule of methane with formation of sodium arsenate (b).



Auger, Compt. rend., **146**, 1281 (1908)

38

**NaOH****I-1969**

If disodium methyl arsenite is heated with an excess of sodium hydroxide to 250–280°, sodium arsenate and methane are formed.

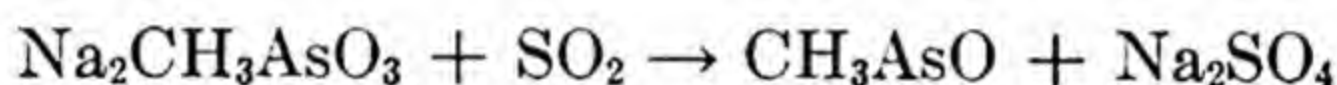


Auger, Compt. rend., **146**, 1280 (1908)

38

**SO₂****I-1970**

Disodium methyl arsenite is converted to methyl arsenic oxide by sulfur dioxide.

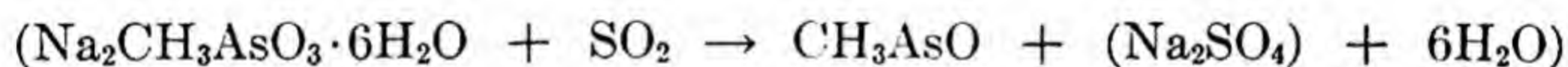


Uhlinger and Cook, J. Ind. Eng. Chem., **11**, 105 (1919)

22

**SO₂****I-1971**

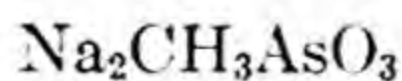
Sulfur dioxide reduces disodium methyl arsenite to methylarsenious oxide.



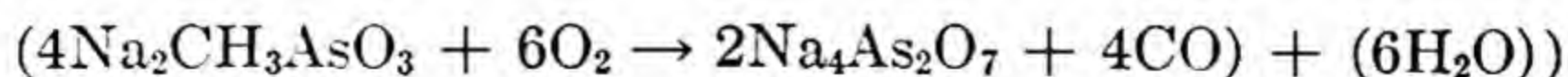
Auger, Compt. rend., **137**, 925 (1903)

Ref., Alex. McKenzie and John K. Wood, J. Chem. Soc., **117**, 407 (1920)

48

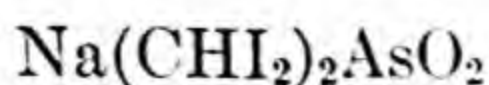
**Δ****I-1972**

Disodium methylarsenite was sealed in a tube with pure nitric acid (sp. gr. 1.35) and heated for 6 hours in order to destroy the organic material. The contents of the tube were allowed to evaporate on the steam bath. The residue was heated to 200° C and finally made red-hot to gain a constant weight product. The product is sodium pyroarsenate.

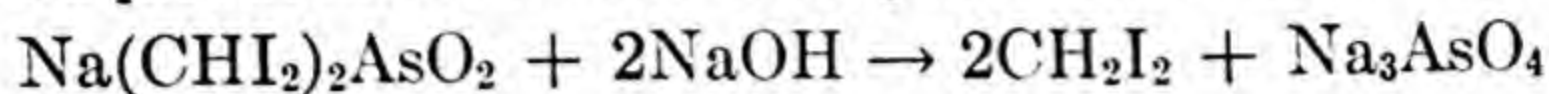


Adrian and Trillat, Ann. Chim. Anal., **7**, 284 (1902)

76

**NaOH****I-1973**

It has been shown that sodium tetraiodocacodylate decomposes when heated with aqueous alkali to form methylene iodide and sodium arsenate.



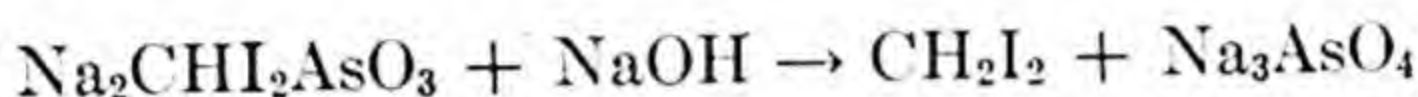
Auger, Compt. rend., **145**, 808 (1907)

Ref.: Auger, Compt. rend., **146**, 1281 (1908)

38

**NaOH****I-1974**

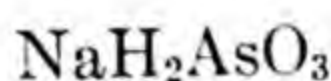
It has been shown that sodium diiodomethylarsenite decomposes when heated with aqueous alkali to form methylene iodide and sodium arsenate.



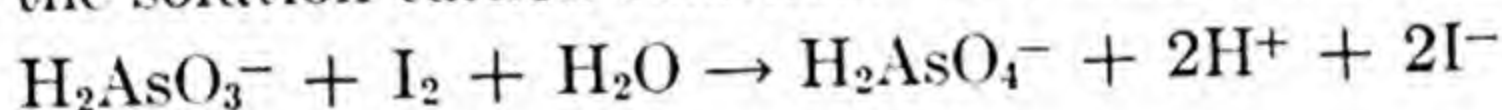
Auger, Compt. rend., **145**, 808 (1907)

Ref.: Auger, Compt. rend., **146**, 1281 (1908)

38

**I₂****I-1975**

5 cc. of a solution of iodine was diluted with 20 cc. water and 0.5 g. of sodium hydrogen carbonate added. The mixture was titrated at once with a standardized solution of sodium dihydrogen arsenite, added dropwise, until the solution turned colorless. No starch was necessary.

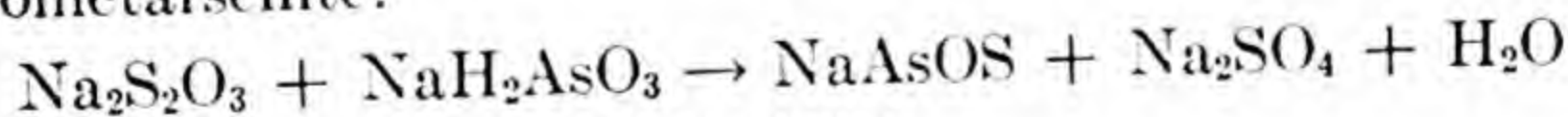


B. S. Alstodt, J. Am. Pharm. A., **29**, 227 (1940)

112

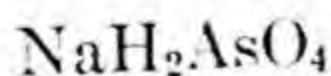
**Na₂S₂O₃****I-1976**

Sodium thiosulfate reacts with sodium dihydrogen arsenite yielding monothiometarsenite.

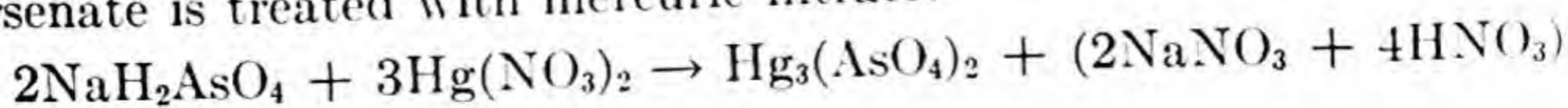


A. Gutmann, Z. anal. Chem., **66**, 224 (1925)

28

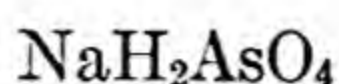
**Hg(NO₃)₂****I-1977**

Mercuric arsenate is formed when a solution of sodium dihydrogen arsenate is treated with mercuric nitrate.



K. Haack, Ann., **262**, 184 (1891)

25

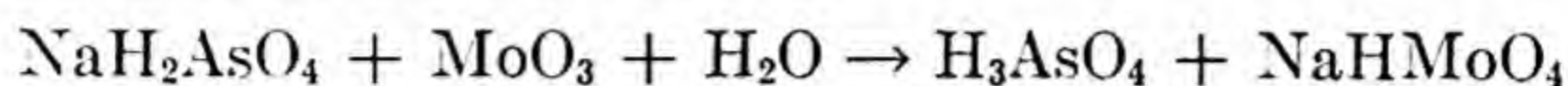


MoO₃

I-1978

H₂O

Arsenic acid is formed when sodium dihydrogen arsenate is acted upon by molybdenum trioxide and water.



C. Friedheim, *Z. anorg. Chem.*, **2**, 364 (1892)

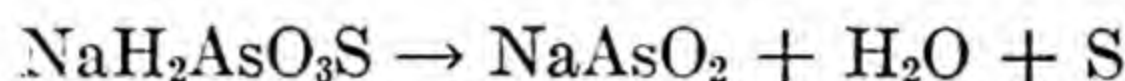
25



Decomp.

I-1979

Sodium dihydrogen monothioarsenate is not stable. After a few hours decomposition takes place.



R. F. Weinland and O. Rumpf, *Z. anorg. Chem.*, **14**, 42 (1897)

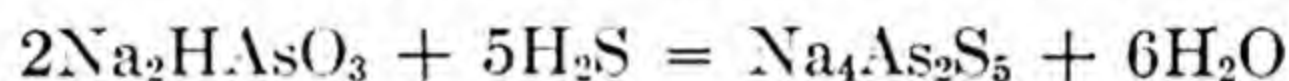
28



H₂S

I-1981

Sodium arsenite absorbs hydrogen sulfide rapidly to form thioarsenites.



Gollmar, *Ind. Eng. Chem.*, **26**, 131 (1934)

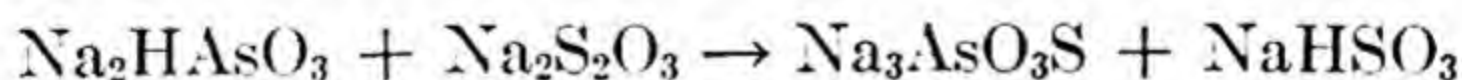
24



Na₂S₂O₃

I-1982

Sodium monothioarsenate is formed when sodium thiosulfate is treated with disodium hydrogen arsenite.



Weinland and Gutmann, *Z. anorg. Chem.*, **17**, 409 (1898)

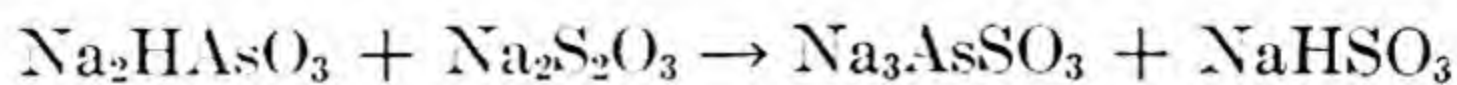
1



Na₂S₂O₃

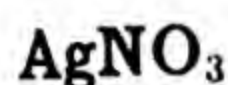
I-1983

Crystals are formed when a concentrated solution of disodium hydrogen arsenite reacts with sodium thiosulfate solution.



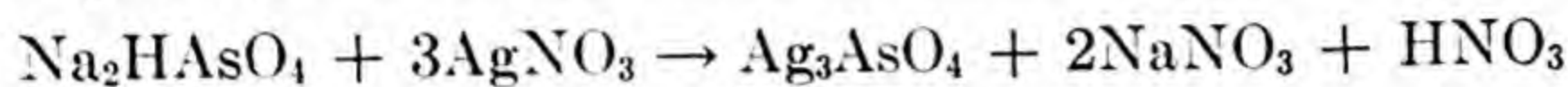
R. F. Weinland and A. Gutmann, *Z. anorg. Chem.*, **17**, 409 (1898)

28



I-1984

Addition of silver nitrate to an arsenate solution does not completely precipitate the arsenate due to the latter's solubility in the nitric acid formed. Addition of an acetic acid-sodium acetate buffer results in complete precipitation of the silver arsenate.

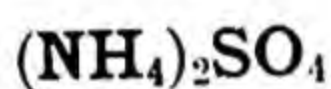


L. Hart, Ind. Eng. Chem., Anal. Ed., **1**, 134 (1929)

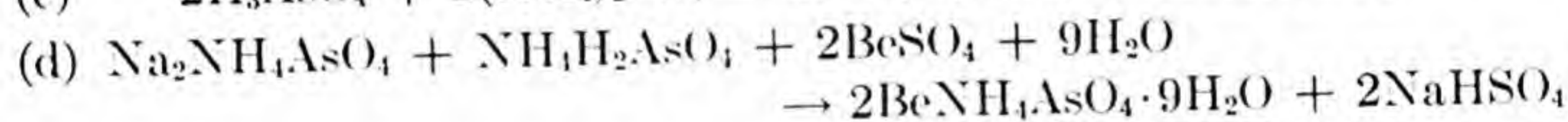
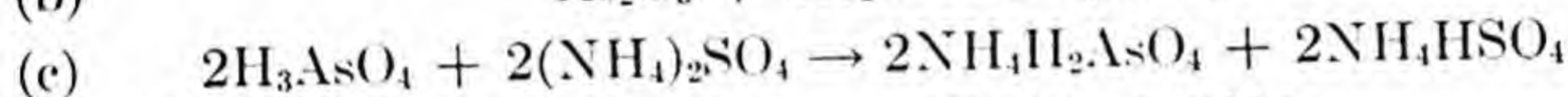
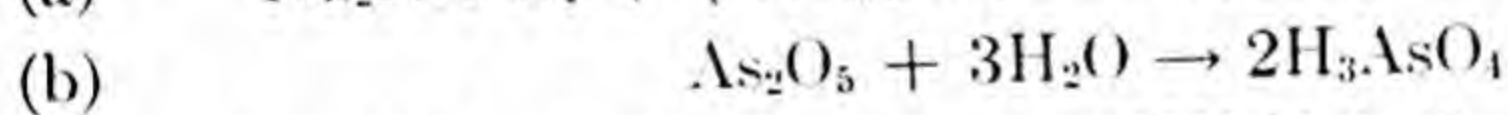
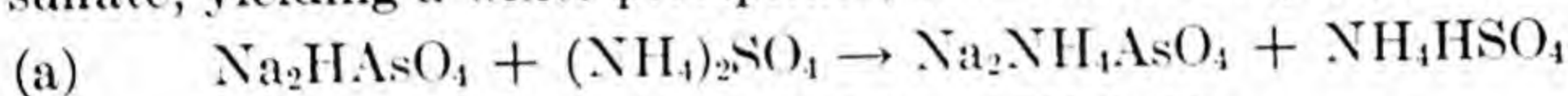
33



I-1985



A solution of disodium orthoarsenate to which ammonium sulfate and arsenic pentoxide were added, will react with a solution of beryllium sulfate, yielding a white precipitate, ammonium beryllium arsenate.



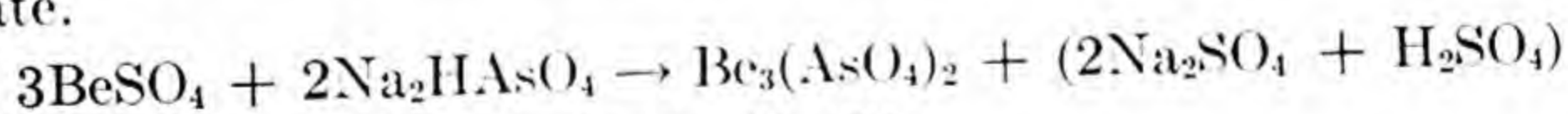
B. Bleyer and Br. Müller, Z. anorg. Chem., **75**, 285 (1912)

28



I-1986

Disodium arsenate precipitates triberyllium arsenate from beryllium sulfate.



Bleyer and Müller, Z. anorg. Chem., **75**, 285

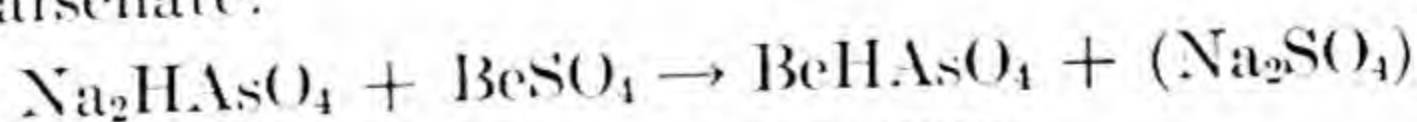
Ref., J. L. Howe, J. Am. Chem. Soc., **35**, 187 (1913)

1



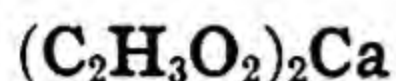
I-1987

Beryllium arsenate is formed when beryllium sulfate reacts with disodium acid arsenate.



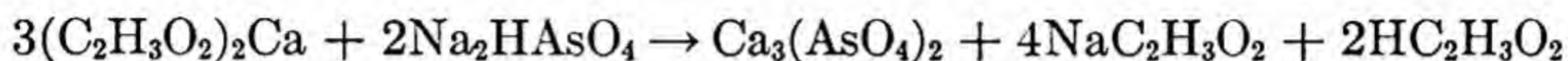
Bleyer and Müller: Z. anorg. Chem., **75**, 287 (1912)

25



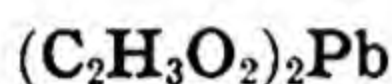
I-1988

The tricalcium salt of arsenic acid is formed by reacting disodium arsenate with calcium acetate.



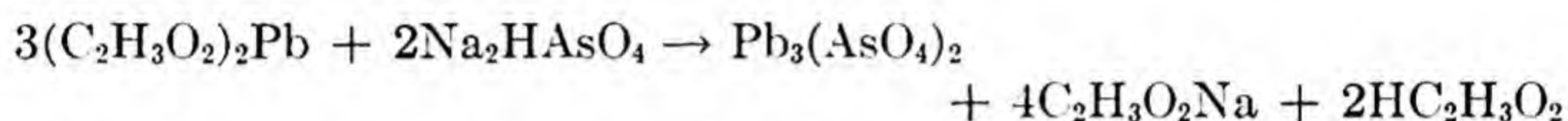
S. V. Pickering, *J. Chem. Soc. (London)*, **91**, 307 (1907)

109



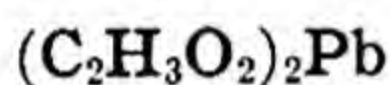
I-1989

Lead acetate reacts with disodium orthoarsenate to produce neutral lead arsenate.



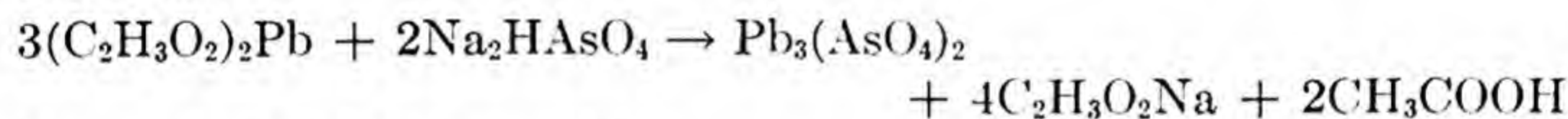
C. W. Drury and C. W. Simmons, *Can. Chem. Met. Eng.*, **9**, 181 (1925)

15



I-1990

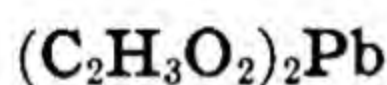
Lead arsenate is formed when lead acetate reacts with disodium orthoarsenate.



Haywood, Bull. 105, Bur. of Chem.

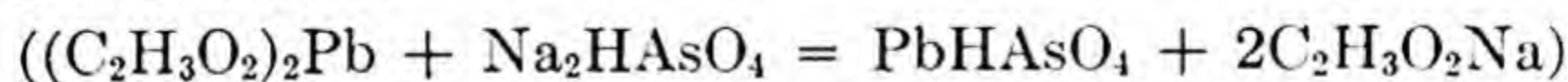
Ref., Tatrar and Robinson, *J. Am. Chem. Soc.*, **36**, 1845 (1914)

1



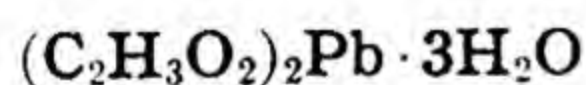
I-1991

Lead hydrogen arsenate may be prepared from lead acetate and disodium orthoarsenate.



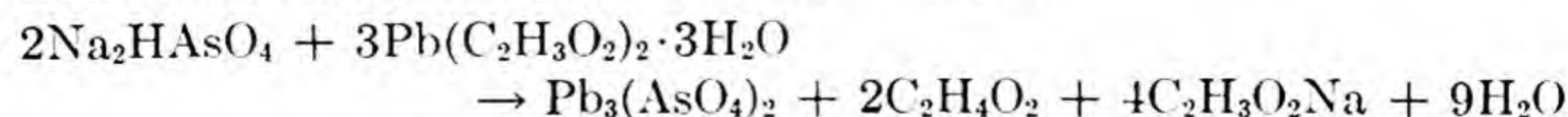
Streeter and Pearce, *Ind. Eng. Chem.*, **23**, 1140 (1931)

24



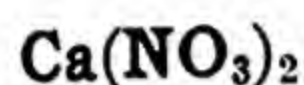
I-1992

Lead acetate, when treated with disodium orthoarsenate, produces lead arsenate, acetic acid, and sodium acetate.



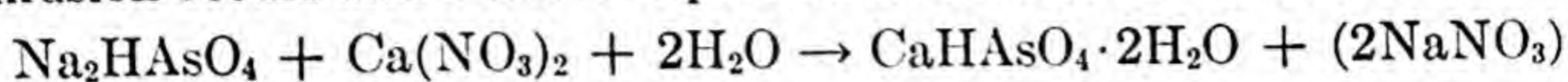
S. U. Pickering, *J. Chem. Soc. (London)*, **91**, 309 (1907)

102



I-1993

If one places a dish containing disodium orthoarsenate in a second, larger dish containing calcium nitrate and then fills both with water diffusion occurs and a salt is deposited on the rim of the inner dish.



H. Dufet, *Compt. rend.*, **106**, 1238-1240

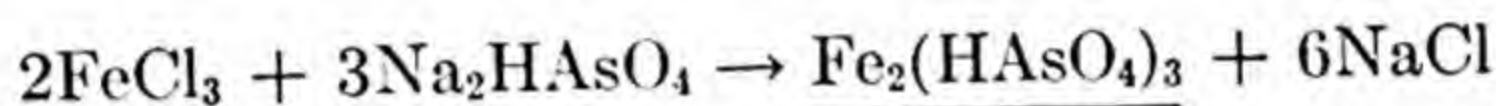
Ref., *Ber.*, **21**, 398 (1888)

25



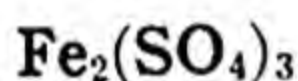
I-1994

A gelatinous precipitate of ferric monohydrogen arsenate forms when a solution of ferric chloride is treated with a solution of disodium orthoarsenate.



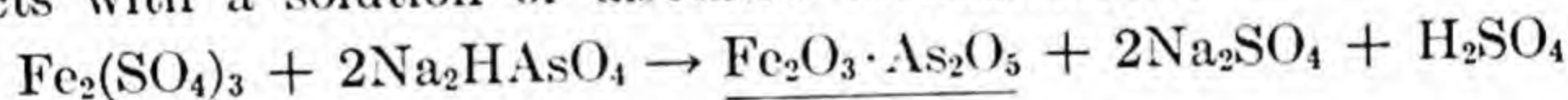
H. N. Holmes and R. E. Rindfusz, *J. Am. Chem. Soc.*, **38**, 1971 (1916)

1



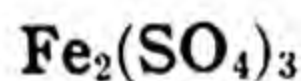
I-1995

A yellow colored precipitate is formed when a solution of ferric sulfate reacts with a solution of disodium orthoarsenate.



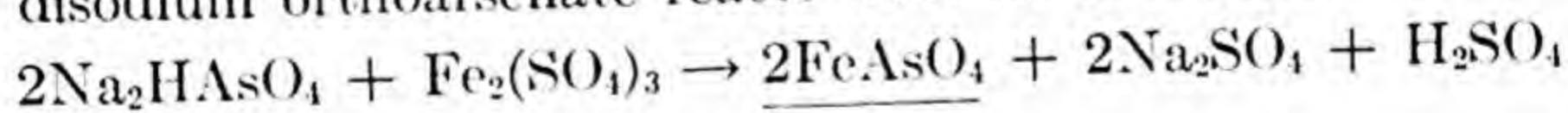
H. Metzke, *Z. anorg. Chem.*, **19**, 457 (1899)

28



I-1996

A fine bright yellow precipitate of neutral ferric orthoarsenate is formed when disodium orthoarsenate reacts with ferric sulfate.



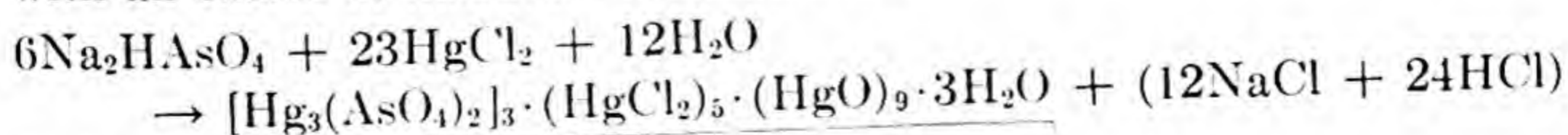
Metzke, *Z. anorg. Chem.*, **19**, 468 (1899)

25



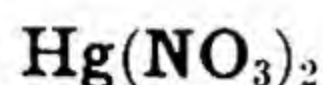
I-1997

A precipitate is formed when a solution of mercuric chloride is treated with an excess of disodium orthoarsenate.



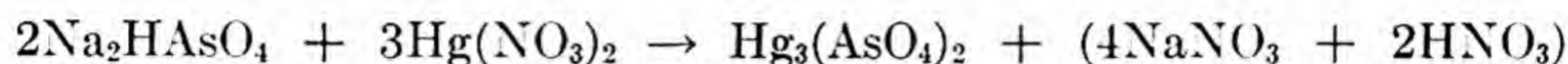
K. Haack, *Ann.*, **262**, 187 (1891)

25



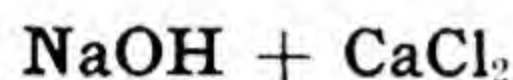
I-1998

Mercuric arsenate is formed when mercuric nitrate reacts with disodium orthoarsenate.



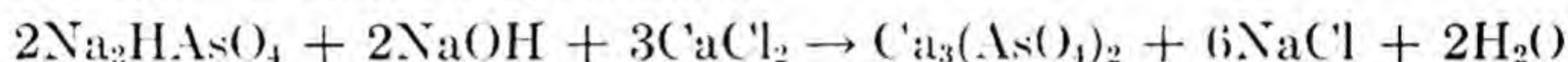
K. Haack: *Ann.*, **262**, 184 (1891)

25



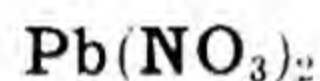
I-1999

If a molecular quantity of sodium hydroxide is added to a solution of disodium orthoarsenate in the presence of an excess of calcium chloride, tricalcium arsenate is produced.



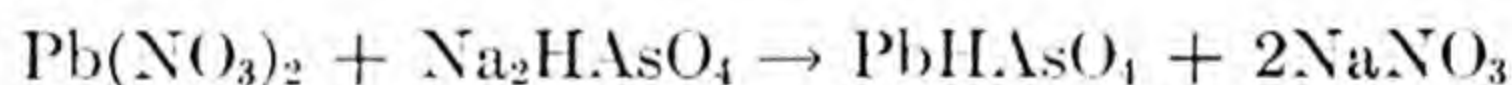
Reedy and Haag, *J. Ind. Eng. Chem.*, **13**, 1038 (1921)

22



I-2000

Lead nitrate reacts with disodium orthoarsenate to produce lead hydrogen arsenate.

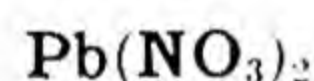


C. W. Drury and C. W. Simmons, *Can. Chem. Met. Eng.*, **9**, 181 (1925)

15

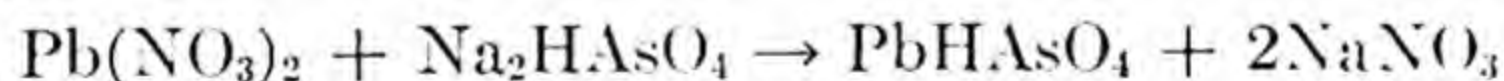
Ref., Jellinek and Kühn, *Z. anorg. Chem.*, **138**, 121 (1924)

25



I-2001

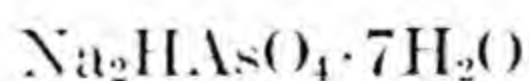
Lead hydrogen arsenate forms when disodium orthoarsenate reacts with lead nitrate.



Haywood, *Bull.* 105, Bur. of Chem.

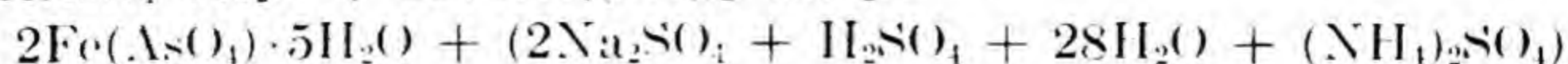
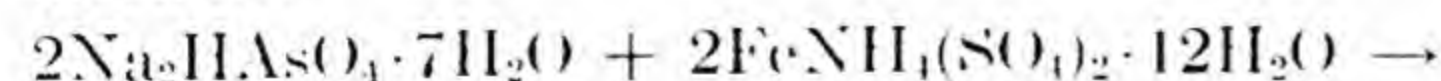
Ref., Tartar and Robinson, *J. Am. Chem. Soc.*, **36**, 1844 (1914)

1



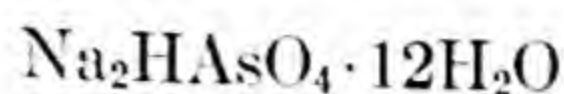
I-2002

A yellow precipitate of ferric orthoarsenate is formed when a solution of ferric ammonium sulfate is dropped into a solution of disodium orthoarsenate.

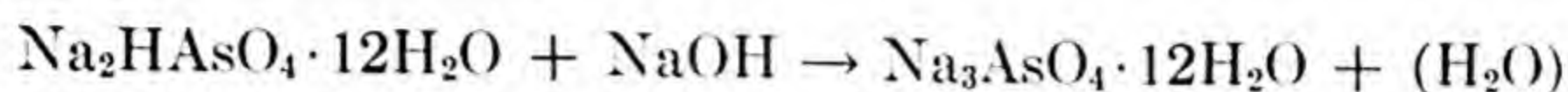


Metzke, *Z. anorg. Chem.*, **19**, 457 (1899)

25

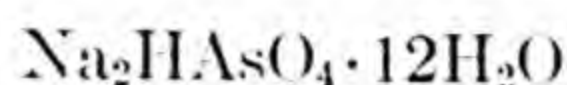
**NaOH****I-2003**

To hydrated disodium arsenate in solution add an equivalent amount of sodium hydroxide. Then concentrate and crystallize, yielding the corresponding trisodium salt.



Thomas Graham, Trans. Roy. Soc. (London), **123**, 253 (1833)

105

**Decomp.****I-2004**

A U-tube is packed with freshly prepared air-dried sodium arsenate dodecahydrate and air is aspirated over the salt for 6 hours. Sodium arsenate heptahydrate is formed, the dissociation pressure of the reaction being 11.10 mm at 25°.

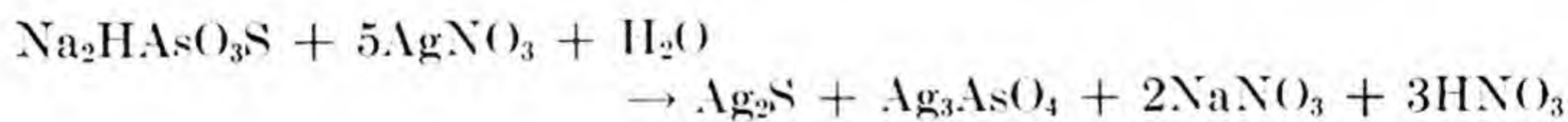


James R. Partington and D. B. Huntingford, J. Chem. Soc., (London), **123**, 168–169 (1923)

48

**AgNO₃****I-2005**

A precipitate of black silver sulfide and red-brown silver arsenate is formed when a solution of disodium monothioarsenate is treated with an excess of silver nitrate.

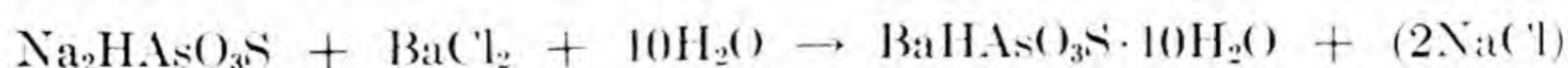


K. Preis, Ann., **257**, 182 (1890)

25

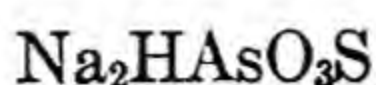
**BaCl₂****I-2006**

Small colorless crystals of barium monothioarsenate separate when a solution of disodium monothioarsenate is treated with a concentrated solution of barium chloride.

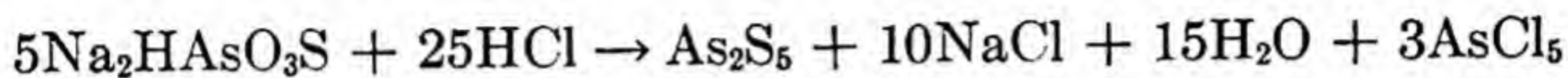


K. Preis, Ann., **257**, 178 (1890)

1

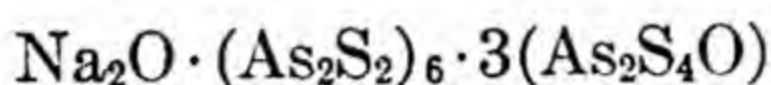
**HCl****I-2007**

A pale yellow precipitate of arsenic pentasulfide is obtained when disodium monothioarsenate is saturated with hydrogen chloride.

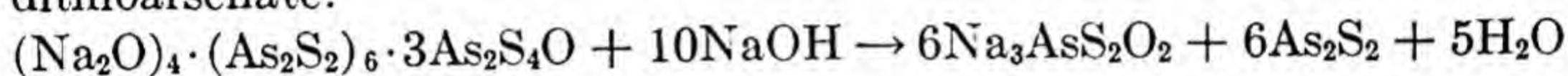


K. Preis, *Ann.*, **257**, 183 (1890)

1

**NaOH****I-2008**

The above salt is decomposed by sodium hydroxide into arsenic disulfide dithioarsenate.

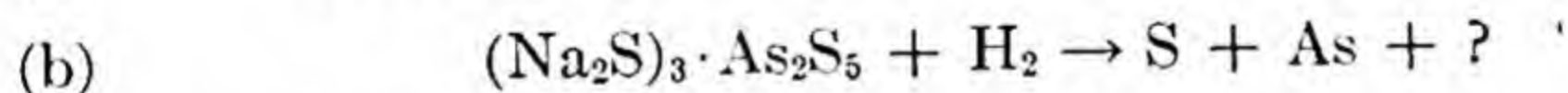
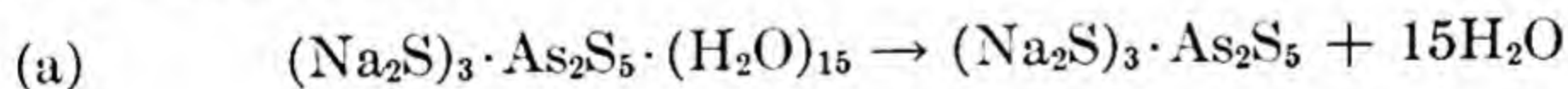


K. Preis, *Ann.*, **257**, 195 (1890)

1

**H₂****I-2009**

Crystallized hydrated sodium thioarsenate is reduced by hydrogen. At low temperatures the water of hydration escapes; higher temperatures produce a yellow sublimate, probably sulfur, which later escapes and leaves a distinct arsenic mirror.

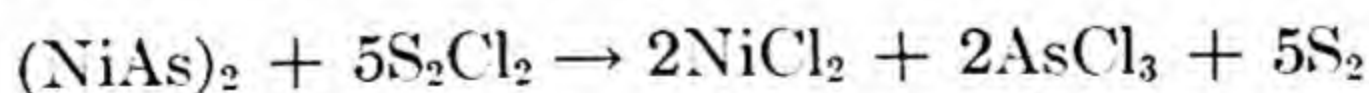


L. F. Nilson, *K. Sv. Vet. Akad. Handl.*, **10**, 13 (1871)

10

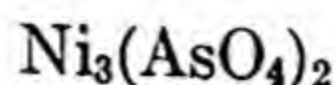
**S₂Cl₂****I-2010**

Nickel arsenide is decomposed by sulfur monochloride when a mixture is heated in a sealed tube at 170°C.

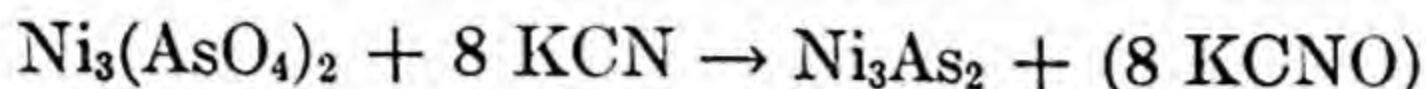


E. F. Smith, *J. Am. Chem. Soc.*, **20**, 292 (1898)

1

**KCN****I-2011**

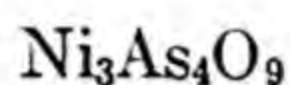
Nickel arsenate (or a mixture of arsenic and nickel oxide) may be reduced by potassium cyanide to form a nickel arsenide.



Descamps, *Compt. rend.*, **86**, 1022-1065 (1878)

Ref.: E. Vigouroux, *Compt. rend.*, **147**, 426 (1908)

38

**HCl****I-2012**

Nickel tetrarsenite is decomposed by hydrochloric acid, giving arsenic trioxide and nickel chloride.

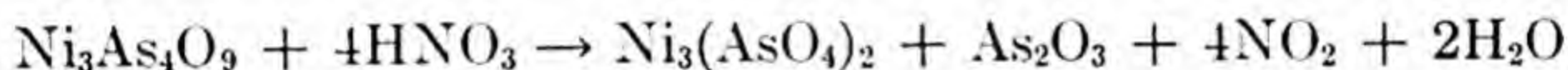


Girard, *Compt. Rend.*, **34**, 919 (1852)

29

**HNO₃****I-2013**

Nickel tetrarsenite is transformed into nickel arsenate and arsenic trioxide by the action of nitric acid.

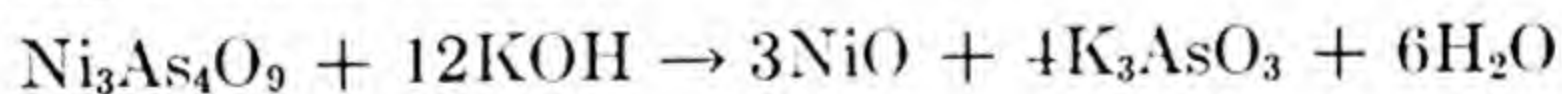


Girard, *Compt. Rend.*, **34**, 919 (1852)

29

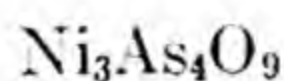
**KOH****I-2014**

Upon heating with potassium hydroxide, nickel tetrarsenite is decomposed, giving a black precipitate of nickel oxide.

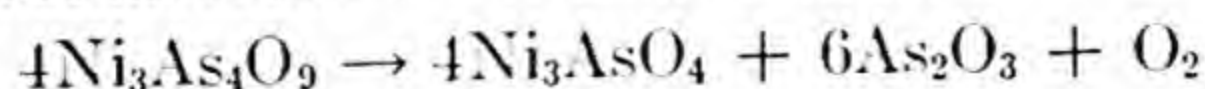


Girard, *Compt. Rend.*, **34**, 919 (1852)

29

**Δ****I-2015**

Upon heating nickel tetrarsenite in air, a sublimate of arsenic trioxide is formed and nickel arsenate is left as a residue.



Girard, *Compt. Rend.*, **34**, 919 (1852)

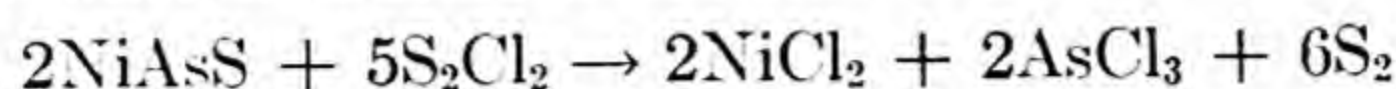
29

NiAsS

S₂Cl₂

I-2016

Nickel monothioarsenide, (gersdorffite), is fully decomposed by sulfur monochloride when a mixture is heated to 170°C. in a sealed tube.



E. F. Smith, J. Am. Chem. Soc., **20**, 292 (1898)

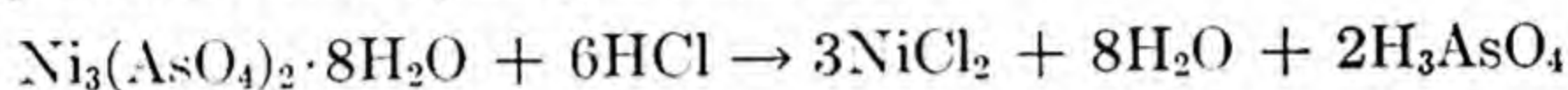
1

Ni₃(AsO₄)₂·8H₂O

HCl

I-2017

A salmon-colored nickel chloride is obtained when nickel arsenate is slightly heated with hydrogen chloride.



J. B. Moyer, J. Am. Chem. Soc., **18**, 1043 (1896)

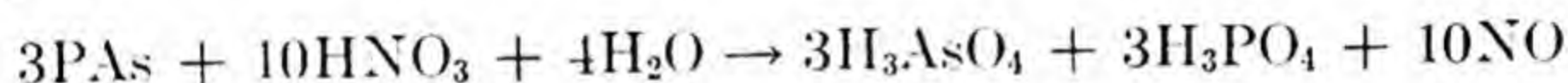
1

PAs

HNO₃

I-2018

Dilute nitric acid oxidizes phosphorus arsenide to arsenic and phosphoric acids.



Jac. V. Janowsky, Ber., **6**, 217 (1873)

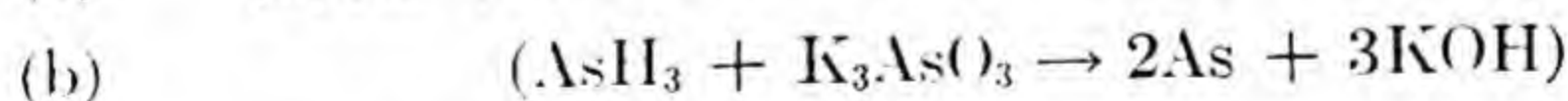
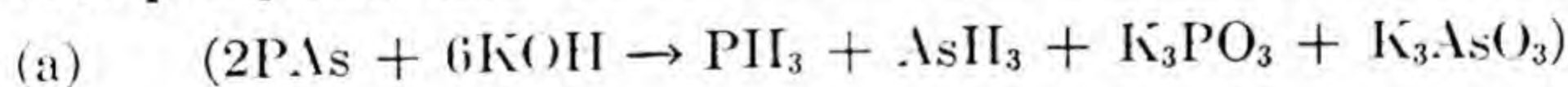
11

PAs

KOH

I-2019

Potassium hydroxide reacts with phosphorus arsenide in the cold to form phosphine, arsine, arsenious acids, and arsenic.



Jac. V. Janowsky, Ber., **6**, 217 (1873)

11

PAs

O₂

I-2020

Phosphorus arsenide burns in the air to phosphorus and arsenic pentoxide.



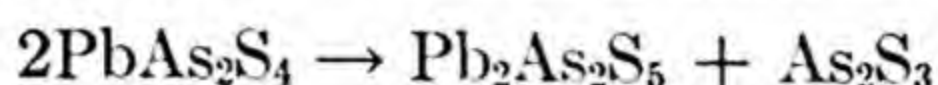
Jac. V. Janowsky, Ber., **6**, 217 (1873)

11

 Δ

I-2021

Dufrenoy'site is formed when skleroklas is heated.



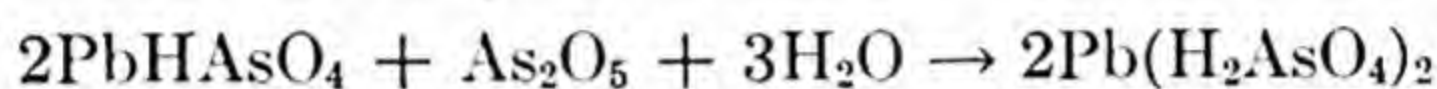
Sommerlad: Z. anorg. Chem., **18**, 420 (1898)

25

 S_2O_5

I-2022

Monolead arsenate is prepared by adding solid lead hydrogen arsenate to a hot solution of arsenic pentoxide.



Tartar, Rice and Sweo, J. Am. Chem. Soc., **53**, 3950 (1931)

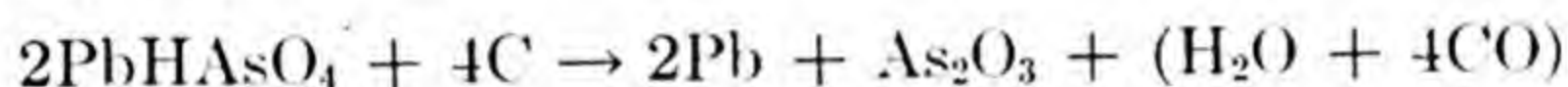
1



C

I-2023

Lead hydrogen arsenate ignited on charcoal gave fumes of arsenic trioxide and metallic lead.



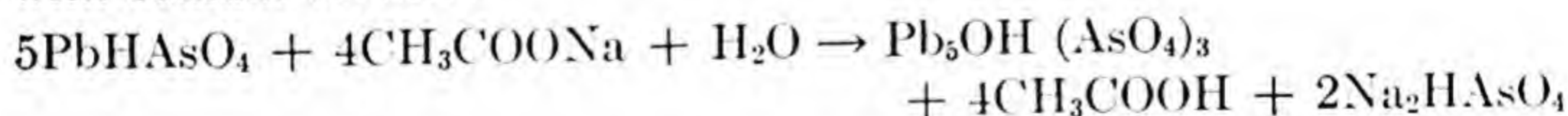
William Gregor, Trans. Roy. Soc. (London), **99**, 198 (1809)

105

 CH_3COONa

I-2024

Lead hydroxyarsenate is formed when lead hydrogen arsenate is treated with sodium acetate.



G. E. Smith, J. Am. Chem. Soc., **38**, 2018 (1916)

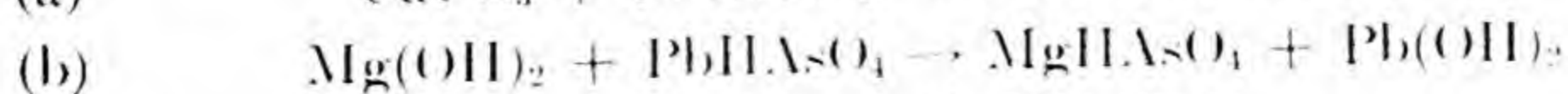
1

 CaCO_3

I-2025

 $\text{Mg}(\text{OH})_2$

Lead hydrogen arsenate reacts with the carbonates and hydroxides of calcium and magnesium in the same general way.

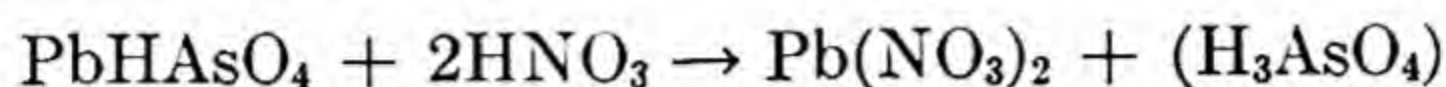


Streeter and Pearce, Ind. Eng. Chem., **23**, 1140 (1931)

24

**HNO₃****I-2026**

Lead hydrogen arsenate is dissolved by nitric acid, yielding lead nitrate and orthoarsenic acid.

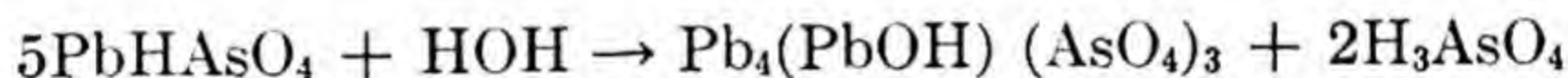


William Gregor, *Trans. Roy. Soc. (London)*, **99**, 198 (1809)

105

**HOH****I-2027**

Hydroxy-minetite is formed when lead hydrogen arsenate is decomposed by water.



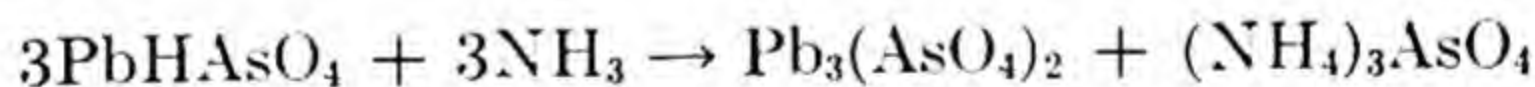
McDonnell and Graham, *J. Am. Chem. Soc.*, **39**, 1912 (1917)

Ref., *J. Chem. Soc. (London)*, **112**, 534 (1917)

1

**NH₃****I-2028**

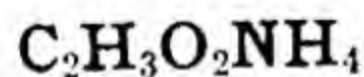
Lead orthoarsenate is formed by the action of ammonia on lead hydrogen arsenate.



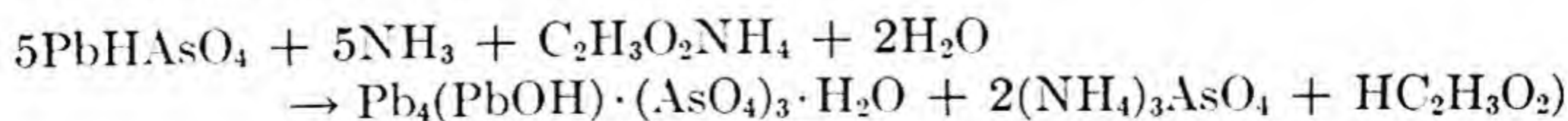
Berzelius, *Ann. Chim. phys.*, (2), **11**, 229 (1819)

Ref., McDonnell and Smith, *J. Am. Chem. Soc.*, **38**, 2032 (1916)

1

**NH₃****I-2029**

Tetralead-hydroxyarsenate is produced when lead hydrogen arsenate is added to hot concentrated ammonium acetate solution to which has been added about 1/4 its volume of concentrated ammonia water, and the whole added to a large volume of hot water.



McDonnell and Smith, *J. Am. Chem. Soc.*, **39**, 940 (1917)

1

**NH₄OH****I-2030**

A hydroxy lead orthoarsenate is formed when lead hydrogen arsenate is digested with ammonium hydroxide for three hours on a water bath.

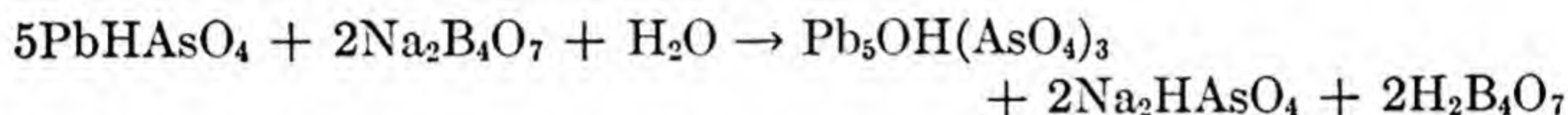


G. E. Smith, J. Am. Chem. Soc., **38**, 2016 (1916)

1

**Na₂B₄O₇****I-2031**

A hydroxy lead arsenate is produced when lead hydrogen arsenate is allowed to react with sodium tetraborate.

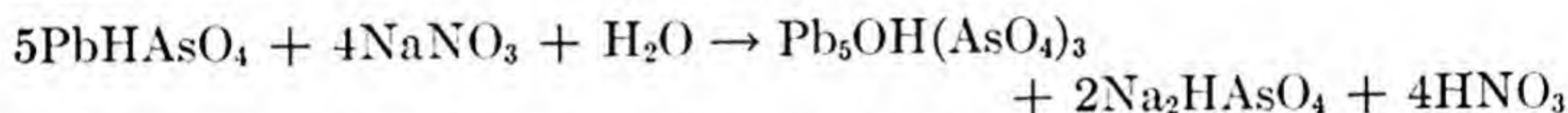


G. E. Smith, J. Am. Chem. Soc., **38**, 2018 (1916)

1

**NaNO₃****I-2032**

Lead hydroxyorthoarsenate is produced when lead hydrogen arsenate is allowed to react with sodium nitrate.

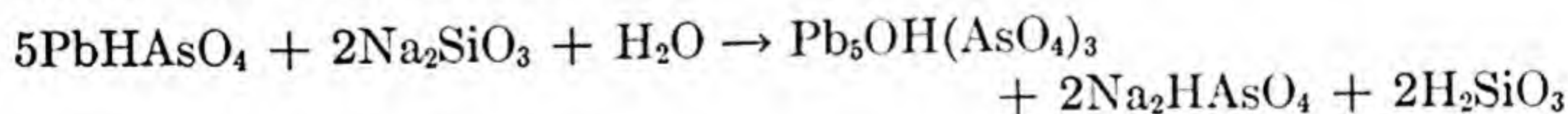


G. E. Smith, J. Am. Chem. Soc., **38**, 2018 (1916)

1

**Na₂SiO₃****I-2033**

Lead hydroxyorthoarsenate is produced when lead hydrogen arsenate reacts with sodium silicate.

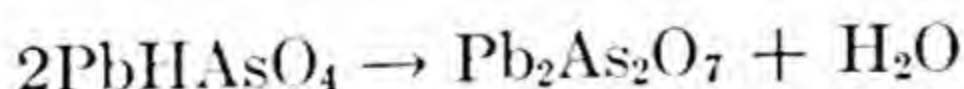


G. E. Smith, J. Am. Chem. Soc., **38**, 2019 (1916)

1

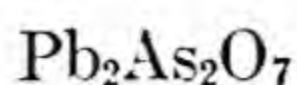
**Δ****I-2034**

Lead pyroarsenate is formed when lead hydrogen arsenate is fused at dull red heat.

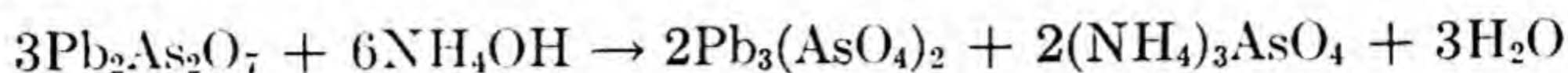


Tartar and Robinson, J. Am. Chem. Soc., **36**, 1849 (1914)

1

**NH₄OH****I-2035**

Lead orthoarsenate is formed when lead pyroarsenate is allowed to react with ammonium hydroxide.



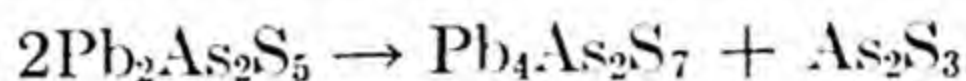
Berzelius,

Ref., Tartar and Robinson, *J. Am. Chem. Soc.*, **36**, 1844 (1914)

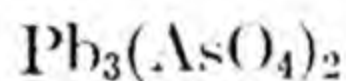
1

**Δ****I-2036**

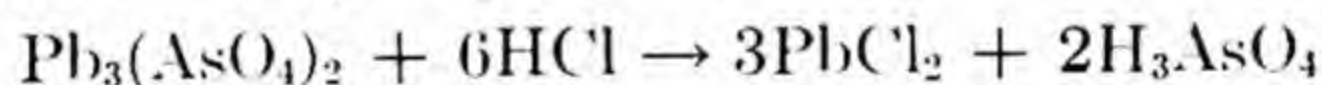
Jordanite is formed when dufrenoyite is heated strongly.

Sommerlad, *Z. anorg. Chem.*, **18**, 420 (1898)

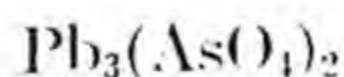
28

**HCl****I-2037**

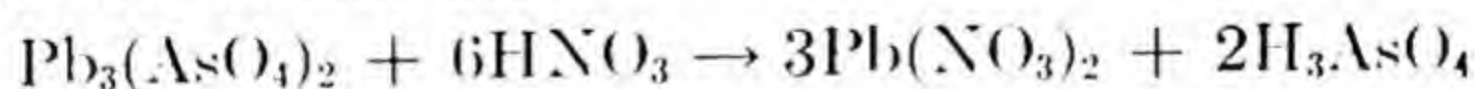
Lead orthoarsenate is converted into the corresponding acid when heated in a current of hydrogen chloride.

Smith and Hibbs, *J. Am. Chem. Soc.*, **17**, 684 (1895)

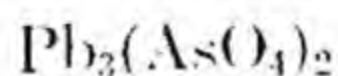
1

**HNO₃****I-2038**

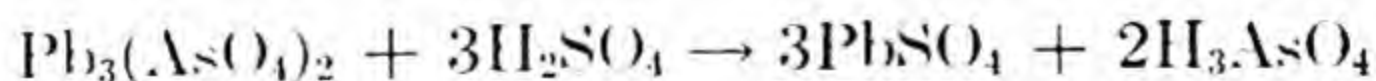
Boil lead orthoarsenate for a time with nitric acid (which may vary in concentration); upon cooling, crystals of lead nitrate deposit and the solution contains arsenic acid.

E. Duvillier, *Compt. Rend.*, **81**, 1251 (1875)

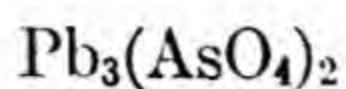
29

**H₂SO₄****I-2039**

Upon adding concentrated sulfuric acid to powdered lead orthoarsenate, heating strongly, and then cooling and diluting with water, lead sulfate is obtained.

U. S. Bur. Chem. Bull., **107**, 239 (1910)Ref., R. C. Roark, *J.A.O.A.C.*, **3**, 163 (1917)

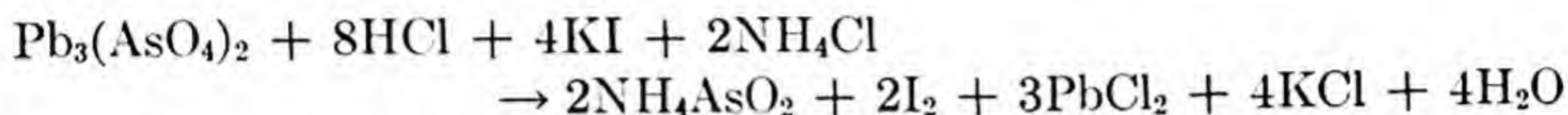
42



KI

I-2040

Arsenic is reduced from the penta to the trivalent state and iodine is liberated when powdered lead orthoarsenate, dissolved in concentrated HCl, is treated with potassium iodide and ammonium chloride solution 35°–40°C. Calcium arsenate undergoes a similar reaction.



W. A. H. Naylor, *Pharm. J. and Trans.*, **10**, (3), 441–2 (1879)

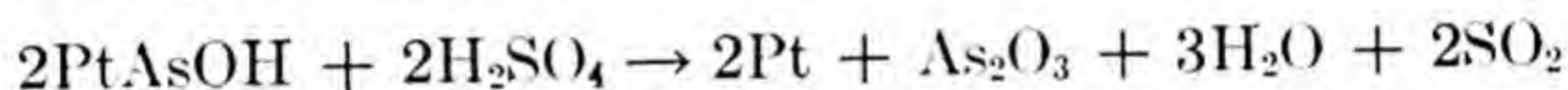
Ref., R. C. Roark, *J.A.O.A.C.*, **3**, 164, ff. (1917)

42

H₂SO₄

I-2041

Concentrated sulfuric acid decomposes platinum arsenic hydroxide into metallic platinum and arsenic trioxide when warmed.



D. Trivoli: *Gazz. chim. Ital.* (**14**), 487 (1884)

Ref., *Ber.* **18**, 137 (1885)

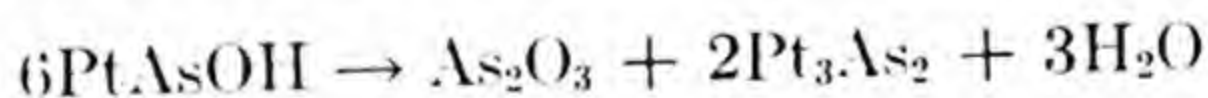
25



Δ

I-2042

A platinum arsenide is formed when platinum arsenic hydroxide is heated strongly in a stream of dry carbon dioxide.



D. Trivoli, *Gazz. chim. Ital.*, **14**, 487 (1884)

Ref., *Ber.*, **18**, 137 (1885)

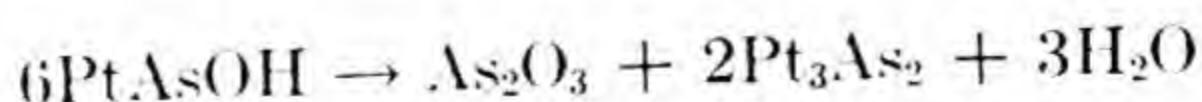
25



Δ

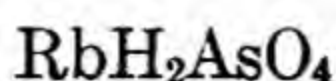
I-2043

If arsenious hydroxyplatinate is heated the following reaction takes place:

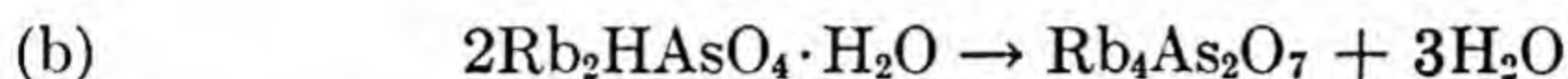
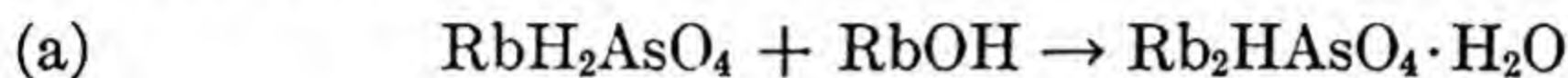


D. Trivoli, *Gazz. chim. Ital.* **14**, 489 (1884)

21

**RbOH****I-2044**

Dirubidium orthoarsenate is obtained by treating 1 mole of rubidium dihydrogen arsenate with 1 mole of rubidium hydroxide. On heating the product rubidium pyroarsenate is formed.



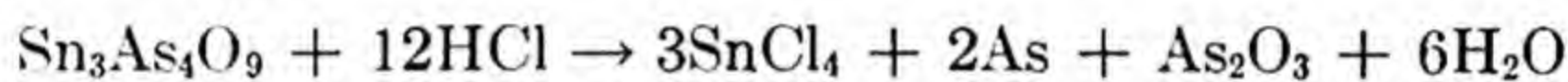
A. Bouchonnet, *Compt. Rend.*, **144**, 641, 18, 3 (1907)

Ref., R. Marquis, *Bull. Soc. Chim.*, [4], **1**, 646 (1907)

31

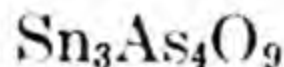
**HCl****I-2045**

Metallic arsenic is precipitated when stannous arsenite is digested with hydrochloric acid.

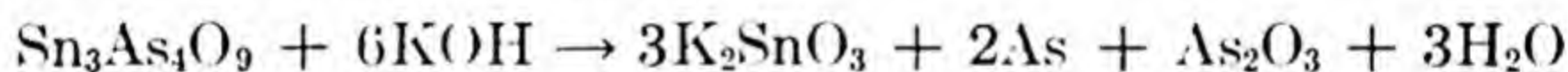


C. Reichard, *Ber.*, **27**, 1019 (1894)

25

**KOH****I-2046**

Potassium stannate is formed when stannous arsenite is treated with a solution of potassium hydroxide.

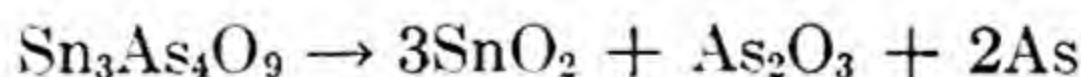


C. Reichard, *Ber.*, **27**, 1019 (1894)

25

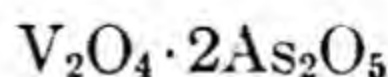
**Δ****I-2047**

Arsenic and arsenic trioxide are formed when stannous arsenite is sublimed.

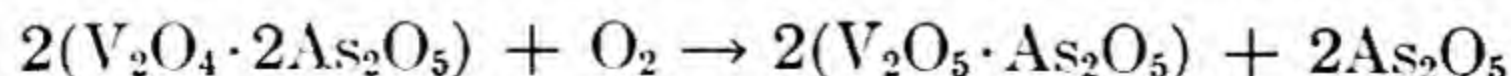


Reichard: *Ber.* **27**, 1019 (1894)

25

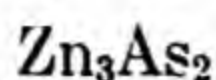
**O₂****I-2048**

Vanadium arsenate is formed when divanadyl arsenate is oxidized.



C. Friedheim, *Ber.*, **23**, 2600 (1890)

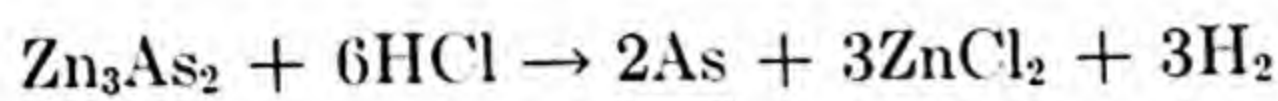
25



HCl

I-2049

When zinc arsenide is dissolved in hydrochloric acid, a small quantity of arsenic precipitates as a brown, finely divided material.



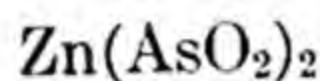
Cf. Soubeiran, *Ann. chim. phys.* 2nd ser. **43**, 421 (1830)

Ref., *Wiederhold, Pogg. Ann.*, **118**, 615

“ *Janowski, Bull. Soc. Chim.*, **20**, 77

“ *Engel, Compt. Rend.*, **77**, 1545 (1873)

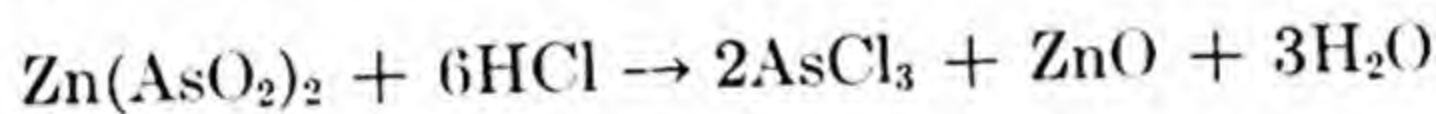
29



HCl

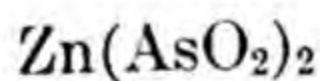
I-2050

Arsenic is removed from powdered zinc arsenite as the volatile tri-chloride upon addition of a mixture of equal amounts of hydrobromic and hydrochloric acids and evaporation to dryness. Any As^{V} present is reduced to As^{III} by the hydrogen bromide.



R. C. Roark, *J.A.O.A.C.*, **3**, 174, 338 (1917)

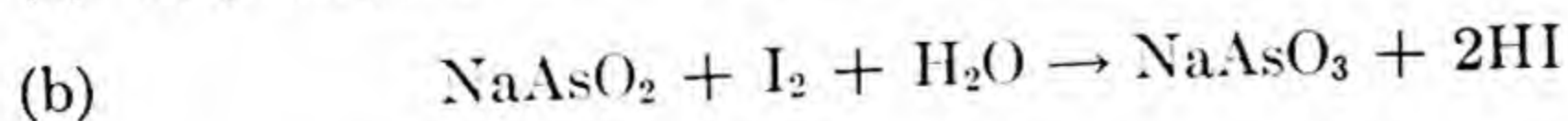
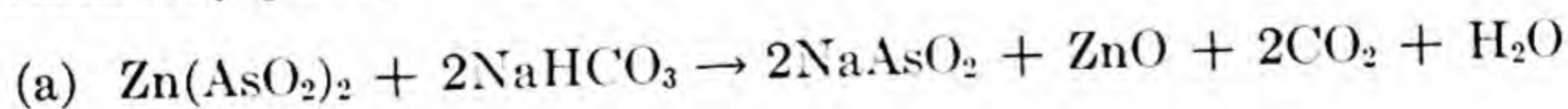
42

NaHCO₃

I-2051

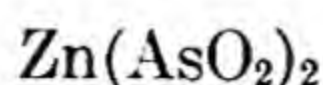
To determine arsenic as As^{III} in a sample of zinc metarsenite, the sample is dissolved in acetic acid, heated if necessary, and filtered after addition of oxalic acid. The solution is treated with H_2SO_4 and KI and then boiled. Excess iodine is removed with thiosulfate solution. After addition of sodium bicarbonate in excess, titration with standard iodine determines arsenic as As^{III} .

Antimony present is also determined by this method.



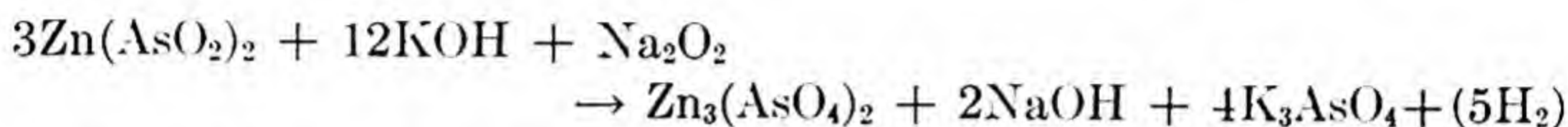
R. C. Roark, *J.A.O.A.C.*, **3**, 175, (1917)

42



I-2052

Arsenic in zinc meta arsenite (dissolved in dil. H_2SO_4 and then made alkaline with KOH) is oxidized to arsenate with sodium peroxide. The zinc is then deposited electrically with a rotating anode, in a nickel crucible.



Balls and McDonnell, *J. Ind. Eng. Chem.*, **7**, 26, (1915)

Ref., R. C. Roark, *J.A.O.A.C.* **3**, 174, (1917)

42

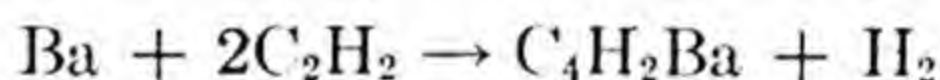
BARIUM



I-2053

The blue solution of barium metal in liquid ammonia is added to a solution of acetylene in the same solvent, without allowing the entire body of reacting solution to become blue at any time. The reaction requires about 40 minutes.

The product is very unstable and decomposes after standing for a few moments, even in an atmosphere of ammonia.



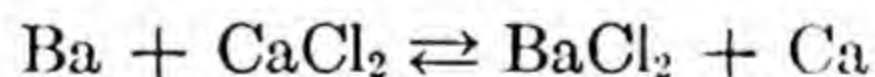
Vaughn, Hennion, Vogt and Nieuwland, *J. Org. Chem.* **2**, 1 (1938)

77



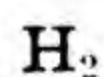
I-2054

The equilibrium of barium metal with molten calcium chloride is determined electrochemically at about 1000°C .



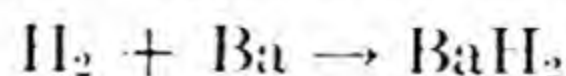
K. Jellinek, J. Czerwinski, J. Wolff and G. Tomoff, *Z. Elektrochem.*, **31**, 543 (1925)

86



I-2055

Barium heated in a current of hydrogen forms barium hydride.



Guntz, *Ann. chim. phys.* [VIII] **4**, 19 (1905)

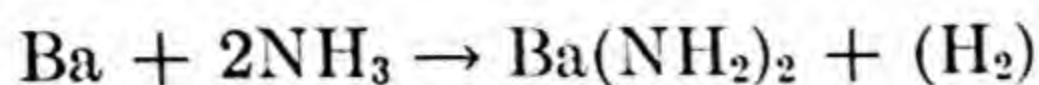
100

Ba

NH₃

I-2056

Barium amide forms by action of ammonia on barium at 280°.



Guntz and Mentrel, Bull. Soc. Chim., (3), **29**, 585

Ref., J. Am. Chem. Soc., **25**, 1293 (1903)

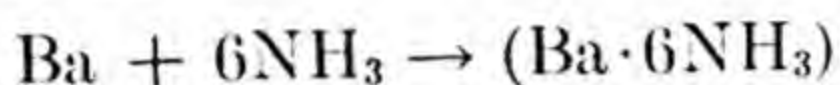
1

Ba

NH₃

I-2057

Barium hexammoniate is formed when barium unites with ammonia at temperatures not above 28°.



Guntz and Mentrel, Bull. Soc. Chim., (3), **29**, 585

Ref., J. Am. Chem. Soc., **25**, 1293 (1903)

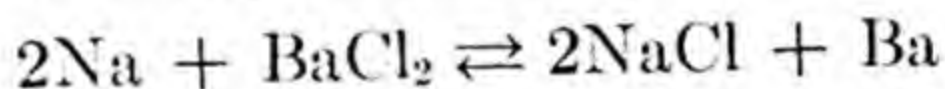
1

Ba

Na

I-2058

The equilibrium between sodium metal and molten barium chloride is determined electrochemically at about 1000°C.



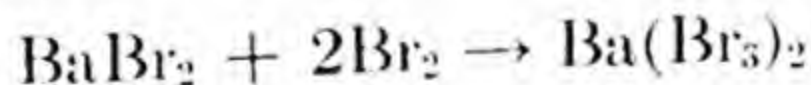
K. Jellinek, J. Czerwinski, J. Wolff and G. Tomoff, Z. Elektrochem., **31**, 543
(1925)

86

BaBr₂Br₂

I-2059

When barium bromide is dissolved in an aqueous solution of bromine, the tribromide is formed.



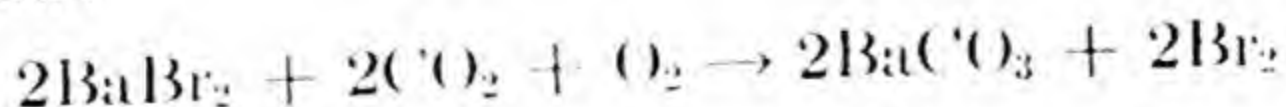
C. K. Tinkler, J. Chem. Soc., (London), **93**, 1614 (1908)

57

BaBr₂CO₂ + O₂

I-2060

A mixture of carbon dioxide and oxygen is passed through a solution of barium bromide.



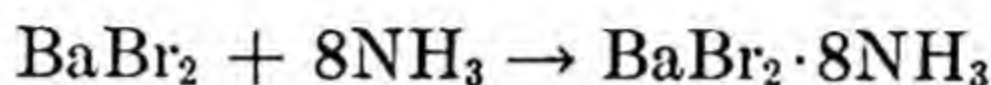
Schilow, Z. Phys. Chem., **42**, 641 (1903)

25

NH₃

I-2061

Recently fused barium bromide reacts with ammonia at -30° and the excess NH₃ evaporated at 0° .



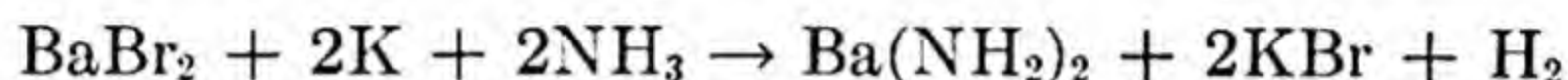
Joannis, Compt. rend. **140**, 1244 (1905)

25

NH₃ + K

I-2062

Barium bromide reacts with liquid ammonia and potassium.



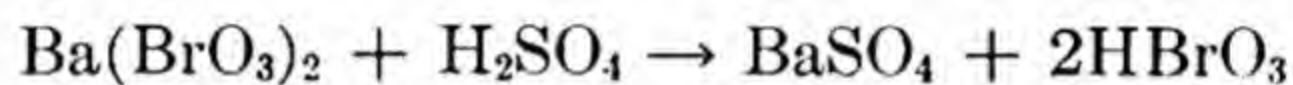
Joannis, Compt. rend., **140**, 1244 (1905)

25

H₂SO₄

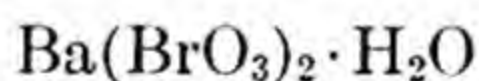
I-2063

A solution of barium bromate reacts with sulfuric acid.



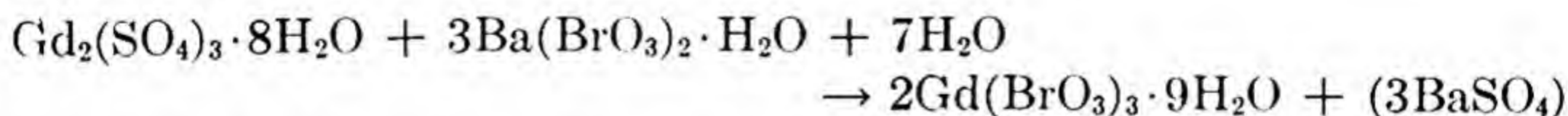
O. Burchard, Z. Phys. Chem., **2**, 796 (1888)

25

Gd₂(SO₄)₃·8H₂O

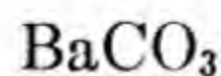
I-2064

Gadolinium bromate crystallized out when a very dilute solution of gadolinium sulfate was added with vigorous stirring to an aqueous suspension of barium bromate and the mixture kept on the steam bath several hours.



Spedding and Nutting, J. Am. Chem. Soc., **55**, 499 (1933)

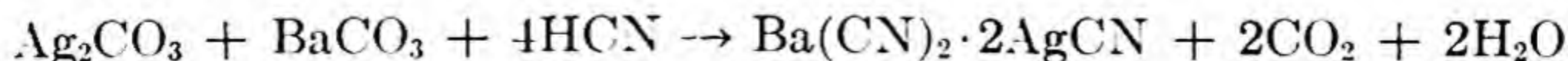
1

Ag₂CO₃

I-2065

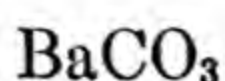
HCN

When hydrogen cyanide is led into a suspension of barium and silver carbonates a double cyanide is formed.



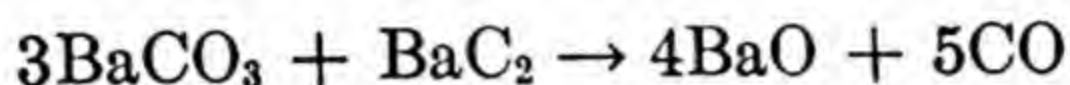
P. Weselsky, Ber. **2**, 589 (1869)

11



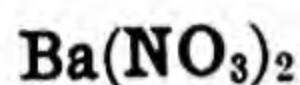
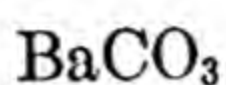
I-2066

A mixture of three equivalent weights of barium carbonate and one of barium carbide is heated to redness without contact of air.



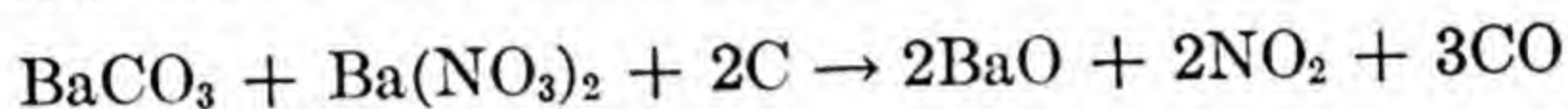
Frank, Ger. Pat. 135,330 (1902)

25



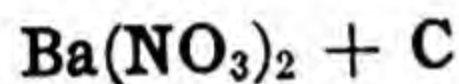
I-2067

The reaction of barium carbonate and barium nitrate heated with coal in an electric furnace to a white heat is as follows:



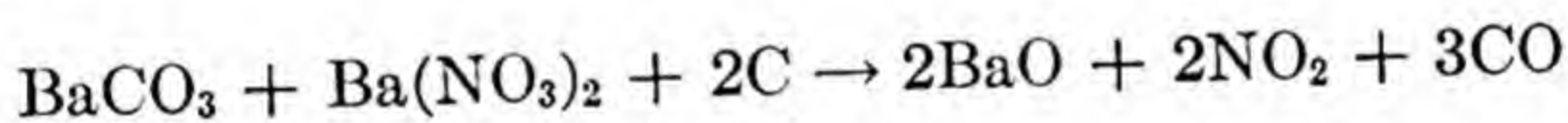
T. H. Norton, J. Ind. Eng. Chem., 5, 704 (1913)

22



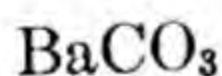
I-2068

A mixture of barium carbonate, barium nitrate, and carbon is heated to redness.



Siemens and Co., Ger. Pat. 158,950 (1903)

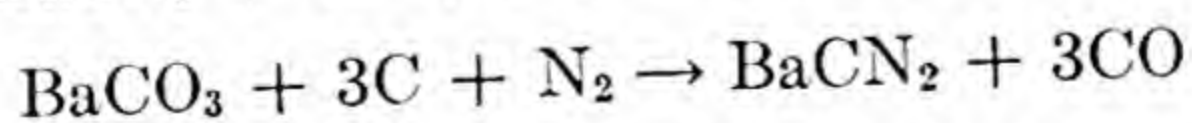
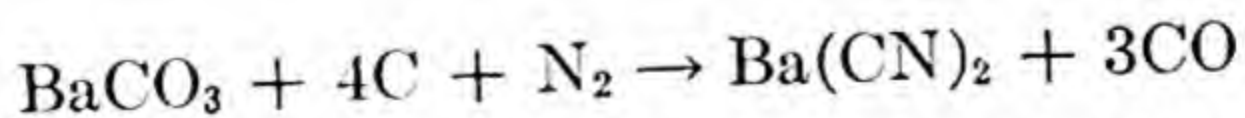
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I-2069

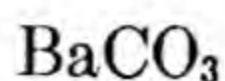


The reactions involving nitrogen fixation are studied in an electric furnace.



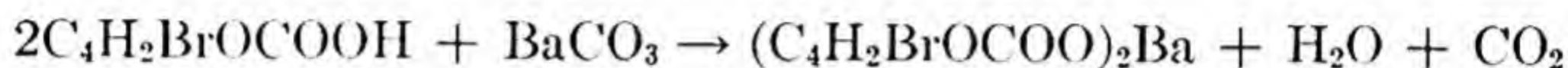
A. Schweitzer, Z. Elektrochem., 32, 99 (1926)

86



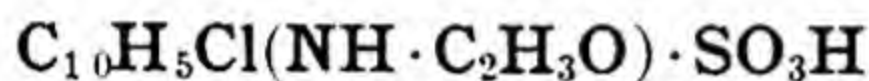
I-2070

A hot aqueous solution of 5-bromo-alpha-furoic acid is saturated with barium carbonate, filtered and allowed to crystallize. Crystals of barium 5-bromo-alpha-furoate with four water separate. A similar reaction occurs when this reagent is treated with calcium carbonate, silver nitrate, sodium carbonate or potassium carbonate. The calcium salt has three H₂O.



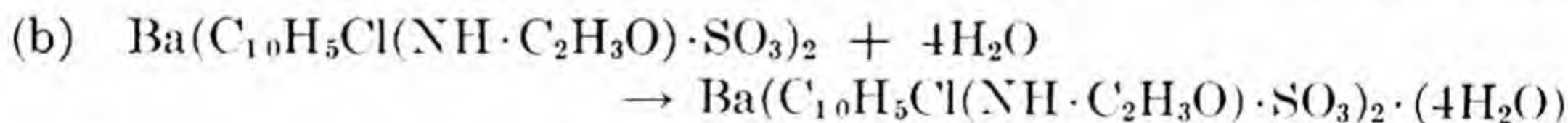
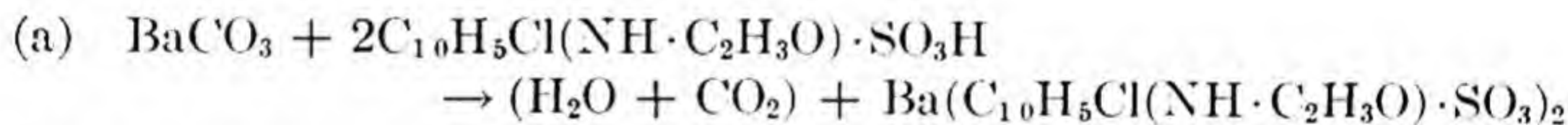
H. Hill and C. Sanger, *Ann.* **232**, 49 (1886)

20



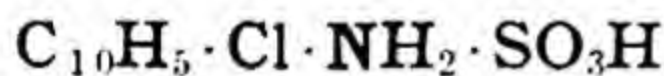
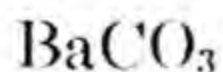
I-2071

When barium carbonate is treated with chloroacetanaphthylamine-sulfonic acid the solution yields the tetrahydrated barium salt of chloroacetanaphthylamine-sulfonic acid as thin, colorless, leaf-like crystals with a pretty silky luster.



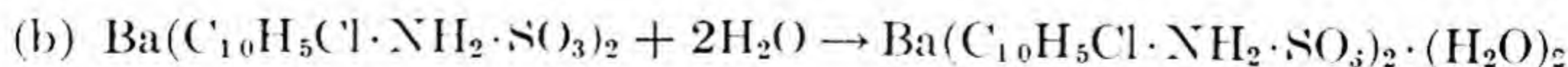
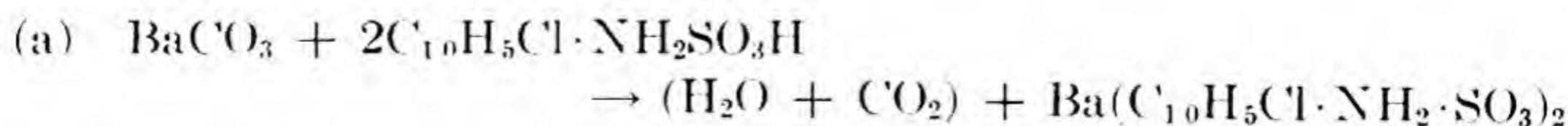
P. Hellström, *K. Sv. Vet. Akad. Handl. Bihang.* **16**, II, No. 3, 67 (1890)

10



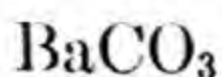
I-2072

When barium carbonate is treated with chloroamidonaphthalene-sulfonic acid the solution yields the di-hydrated barium salt of chloroamidonaphthalene-sulfonic acid as needles with a pale reddish brown tinge.



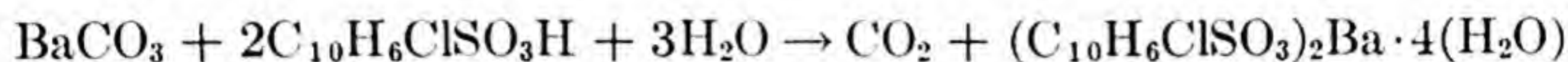
P. Hellström, *K. Sv. Vet. Akad. Handl. Bihang.*, **16**, II, No. 3, 56 (1890)

10

C₁₀H₆ClSO₃H

I-2073

α -monochloronaphthalene-sulfonic acid reacts with barium carbonate and yields on evaporation tetrahydrated barium α -monochloronaphthalene-sulfonate as broad hexagonal tablets.



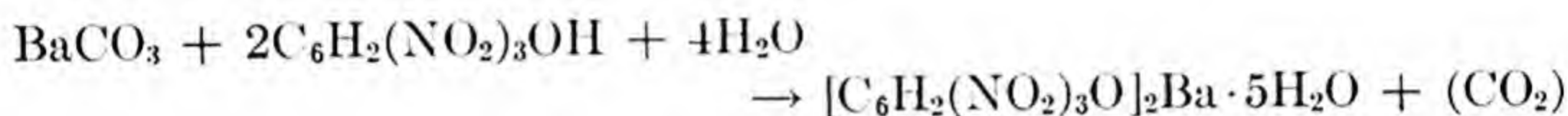
K. E. Arnell, K. S. Vet. Akad. Handl. Öfvers. **40**, No. 6, 64 (1883)

10

**C₆H₂(NO₂)₃OH**

I-2074

When barium carbonate reacts with picric acid solution, barium picrate pentahydrate crystallizes from hot concentrated solution in yellow prismatic needles. This hydrate when heated to 80° forms the anhydrous salt.



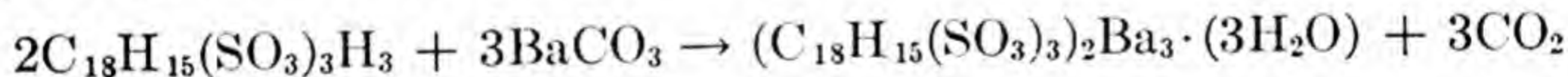
O. Silberrad and H. A. Phillips: J. Chem. Soc., (London), **93**, 481 (1908)

57

**C₁₈H₁₅(SO₃)₃H₃**

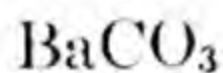
I-2075

Reten-trisulfonic acid reacts with barium carbonate and yields fine, colorless, prismatic needles of barium reten-trisulfonate. The corresponding lead salt is made in similar manner.



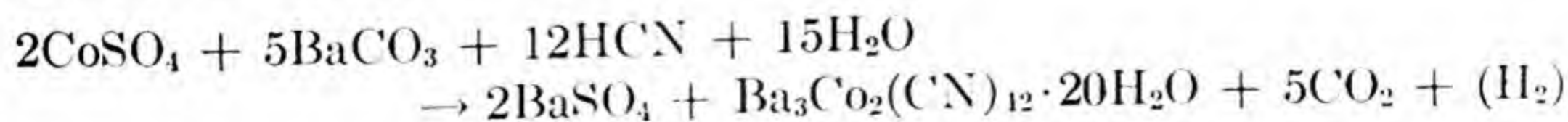
O. G. Ekstrand, K. Sv. Vet. Akad. Handl. Öfvers., **33**, No. 7, 72-74 (1876)

10

**CoSO₄ + HCN**

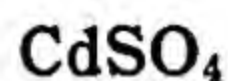
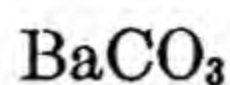
I-2076

When hydrogen cyanide is passed into a solution of cobaltous sulfate (cobalt vitriol) containing barium carbonate, a complex barium cobalt cyanide is formed.



P. Weselsky, Ber., **2**, 590 (1869)

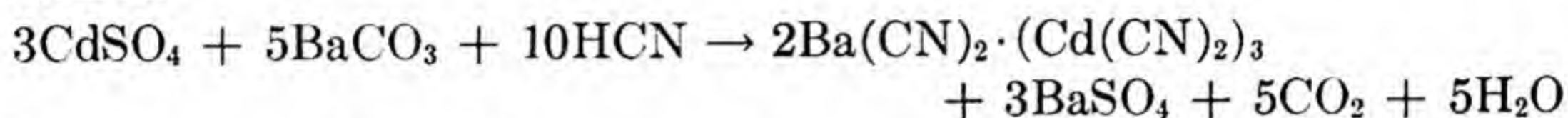
11



I-2077



When hydrogen cyanide is passed into a solution of cadmium sulfate containing barium carbonate, a complex barium cadmium cyanide is formed.



P. Weselsky, Ber., **2**, 590 (1869)

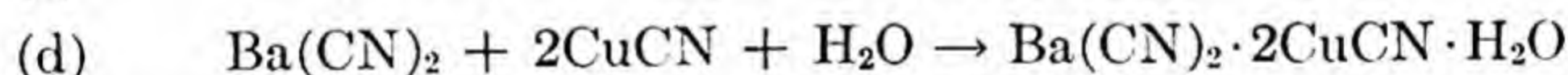
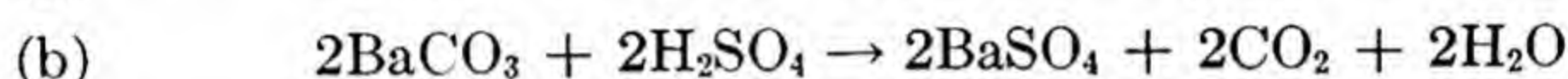
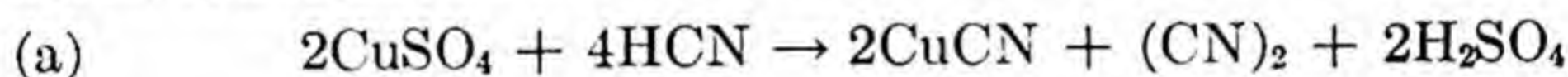
11



I-2078

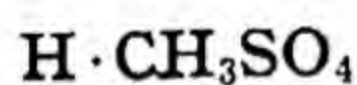


Hydrogen cyanide, when passed into a solution of copper sulfate containing barium carbonate in suspension, forms a complex cuprous barium cyanide, cyanogen, barium sulfate and carbon dioxide.



P. Weselsky, Ber., **2**, 590 (1869)

11



I-2079

Barium carbonate treated with methyl sulfuric acid yields four-sided tablets of di-hydrated barium methyl sulfate.



J. E. Alèn, K. Sv. Vet. Akad. Handl. Öfvers., **37**, No. 8, 12 (1880)

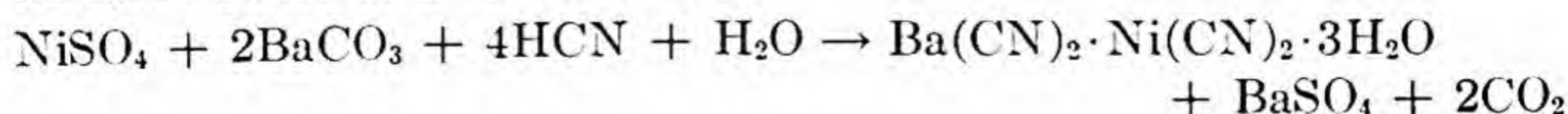
10



I-2080



When hydrogen cyanide is led into a solution of nickel sulfate, containing barium carbonate in suspension, a double salt is formed, as well as barium sulfate and carbon dioxide.



P. Weselsky, Ber., **2**, 590 (1869)

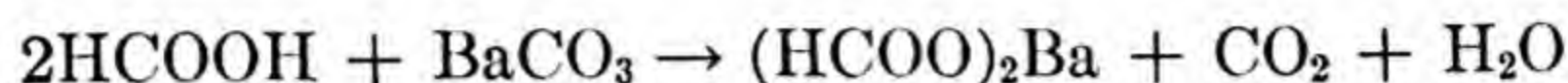
11



HCOOH

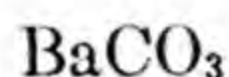
I-2081

Barium formate is produced when pure barium carbonate is dissolved in 90% formic acid.



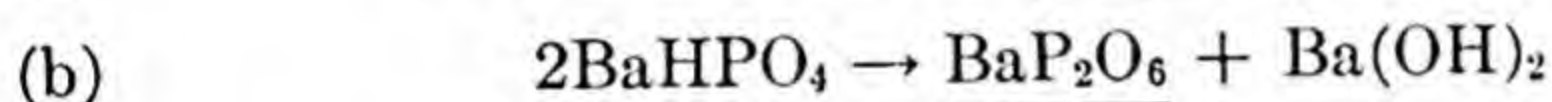
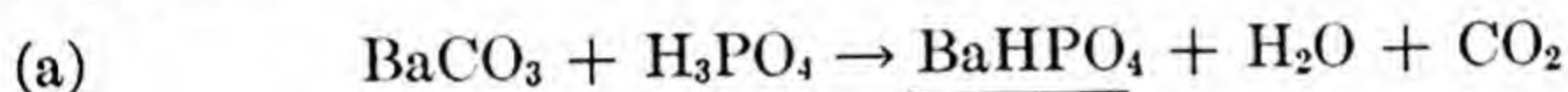
Kendall and Adler, J. Am. Chem. Soc., **43**, 1476 (1921)

1

H₃PO₄

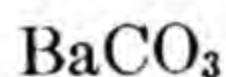
I-2082

Barium carbonate is added to a solution of orthophosphoric acid. Heating on the water bath will precipitate barium hydrogen orthophosphate. This in turn heated on the sand bath will yield barium metaphosphate.



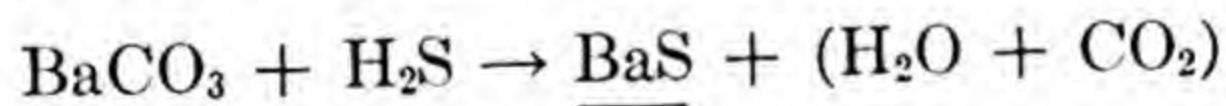
F. Warschauer, Z. anorg. Chem., **36**, 137 (1903)

28

H₂S

I-2083

When one part of barium carbonate in one hundred parts of water is treated with a stream of hydrogen sulfide, a conversion to the sulfide occurs. The reaction is complete in 30 hours if enough water is used. 15.3% is converted if the ratio of salt to water is 1:10 and 51.2% if the ratio of salt to water is 2:100.



L. Naudin and F. de Montholon,
Ref., A. Henninger, Ber., **9**, (2), 1131 (1876)

26

H₂SeO₃

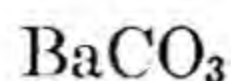
I-2084

Barium carbonate dissolves in selenous acid. The solution, when evaporated at 60°, yields barium selenite selenium dioxide as small prisms.



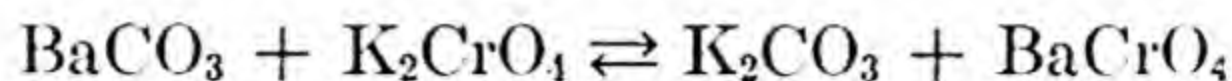
L. F. Nilson, K. Sv. Vet. Akad. Handl. Öfvers., **31**, No. 1, 38 (1874)

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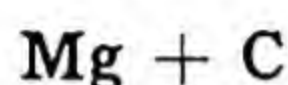
I-2085

The equilibrium of the reaction given below is studied.



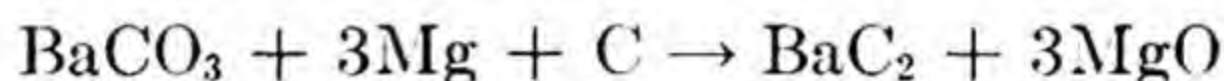
M. Scholtz and R. Abegg, *Z. Elektrochem.*, **12**, 425 (1906)

86



I-2086

Barium carbonate is reduced by a mixture of magnesium and carbon, heated to a high temperature.



L. Maguene, *Ann. Chim. Phys.*, [6] **28**, 258 (1893)

22



I-2087

Barium carbonate heated to a dull red temperature reacts with ammonia.



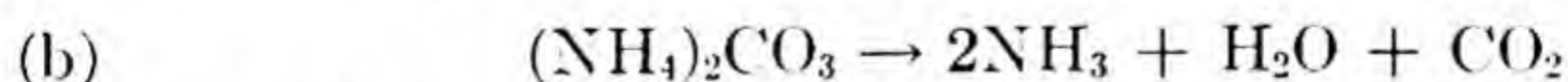
Ger. Pat. 139,456 (1901)

25



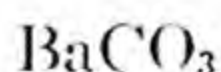
I-2088

If powdered barium carbonate is added to an ammonium chloride solution, and the solution is boiled for some time, part of the barium carbonate becomes barium chloride and another part decomposes.



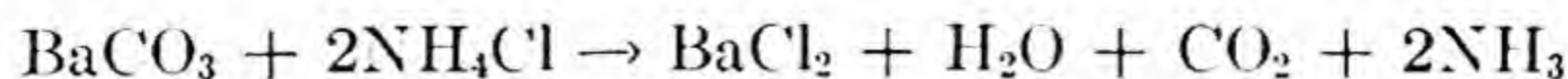
Cantoni and Goguelia, *Ann. Chim. Anal.* **9**, 405 (1904)

76



I-2089

Barium carbonate is decomposed by boiling with a solution of ammonium chloride.



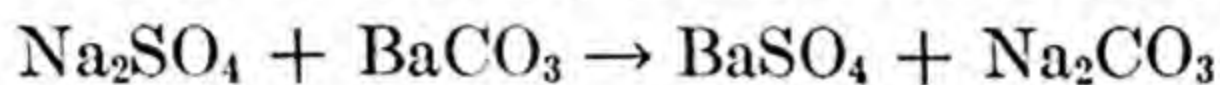
Cantoni and Goguelia, *Bull. Soc. Chim.* [3] **31**, 282

25



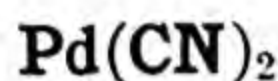
I-2090

Barium carbonate reacts with sodium sulfate in the presence of a trace of sulfuric acid to form barium sulfate and sodium carbonate.



J. Ehrlich, Ann. Chim. Anal. [2], **2**, 214 (1920)

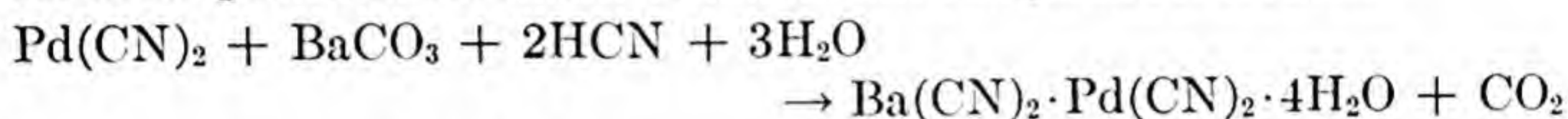
76



I-2091



When hydrogen cyanide is passed into a solution of palladous cyanide containing barium carbonate a double salt compound is formed.



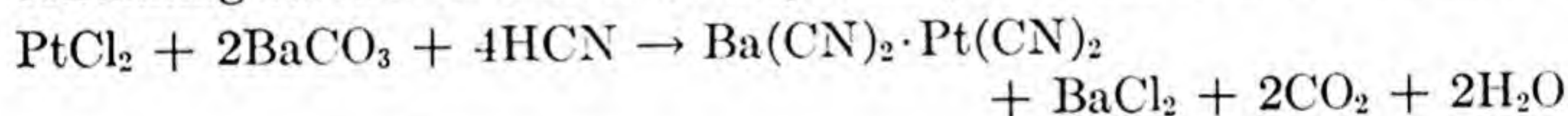
P. Weselsky, Ber. **2**, 590 (1869)

11



I-2092

When hydrogen cyanide is passed into a solution of platinous chloride containing barium carbonate in suspension, a double cyanide is formed.



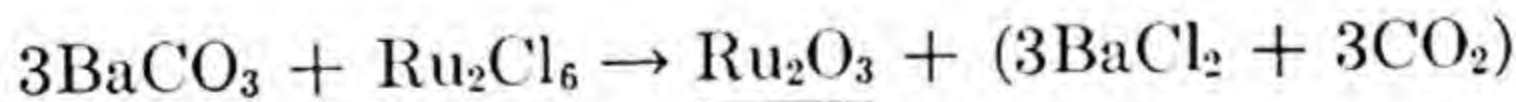
P. Weselsky, Ber., **2**, 588 (1869)

11



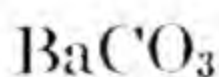
I-2093

If a solution of ruthenium sesquichloride is subjected to treatment by freshly prepared barium carbonate, ruthenium sesquioxide is precipitated.



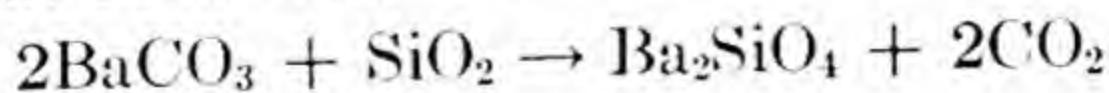
Leidie and Quenessen, Ann. Chim. Anal. **8**, 244 (1903)

76



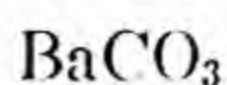
I-2094

A mixture of equivalent quantities of barium carbonate and silicon dioxide is calcined at 1400–1500° C.



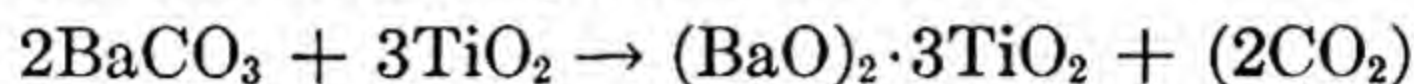
C. Deguide, Fr. Pat. 483,044 (1917)

25

TiO₂

I-2095

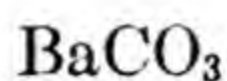
Dibarium trititanate is formed when equal molecules of titanic anhydride and barium carbonate are fused for an hour at red heat and the product treated with dilute hydrochloric acid.



L. Bourgeois, Bull. Soc. Chim. **46**, 262

Ref., M. L., J. Am. Chem. Soc. **8**, 178 (1886)

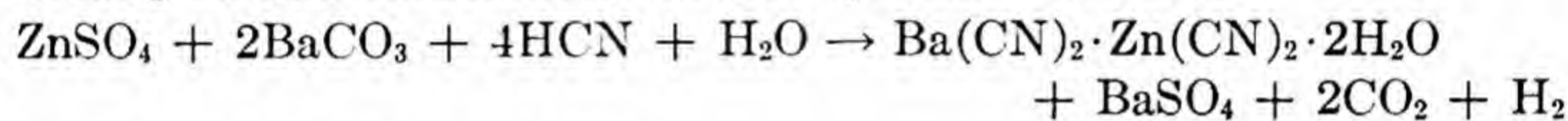
1

ZnSO₄

I-2096

HCN

When hydrogen cyanide is passed into a solution of zinc sulfate containing barium carbonate, a double cyanide is formed.



P. Weselsky, Ber., **2**, 509 (1869)

11



Δ

I-2097

When barium carbonate is heated in a vacuum to 1250°, barium oxide is obtained.



J. B. Pierce, Jr., U. S. Pat. 1,305,618

25



Δ

I-2098

Barium carbonate is heated in a stream of CO₂ to 811°.



Bolke, Z. Anorg. Chem. **50**, 244

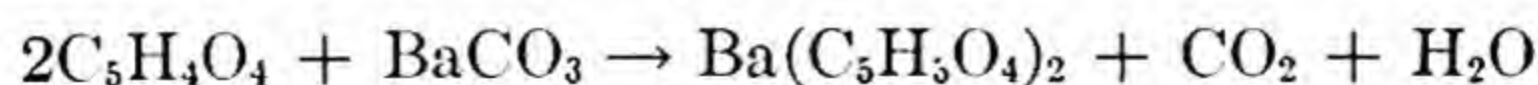
28



Aconic acid

I-2099

An aqueous solution of aconic acid is treated with an excess of barium carbonate, digested, filtered and precipitated by adding the solution to alcohol. Barium aconate precipitates.

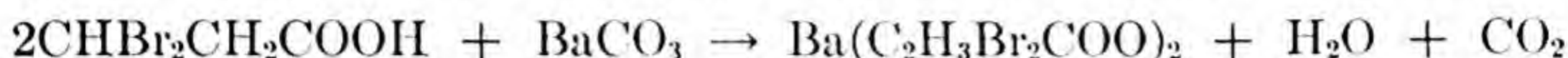


F. Meilly, Ann. **171**, 161 (1874)

20

**Alpha-dibromopropionic acid****I-2100**

Alpha-dibromopropionic acid is dissolved in five times its weight of absolute alcohol and warmed to 50°C. Excess dry barium carbonate is added and, after saturation, the solution is filtered and cooled. Crystals of the barium salt of alpha-dibromopropionic acid with 9H₂O separate.

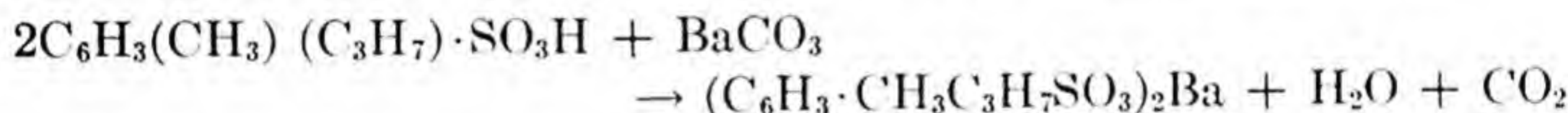


O. Philippi and B. Tollens, *Ann.*, **171**, 321 (1874)

20

**Alpha-meta-isocymolsulfonic acid****I-2101**

An aqueous solution of alpha-meta-isocymolsulfonic acid is neutralized with barium carbonate, the solution filtered, concentrated and cooled. Crystals of barium alpha-meta-isocymolsulfonate separate with one H₂O. A similar reaction occurs when this reagent is treated with lead acetate, potassium carbonate or sodium carbonate. The lead salt contains one H₂O, the potassium three and the sodium one H₂O.

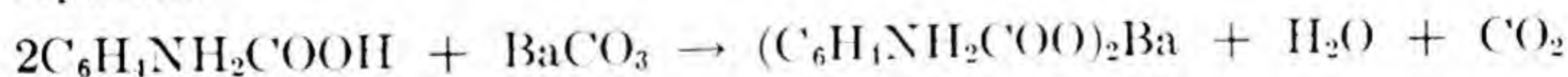


W. Kelbe, *Ann.*, **210**, 31 (1881)

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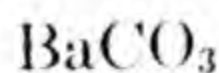
**3-Aminobenzoic acid****I-2102**

3-Aminobenzoic acid is dissolved in water, warming if necessary, and an excess of barium carbonate added. The solution is filtered and concentrated. Crystals of barium-3-amino-benzoate with four H₂O separate.

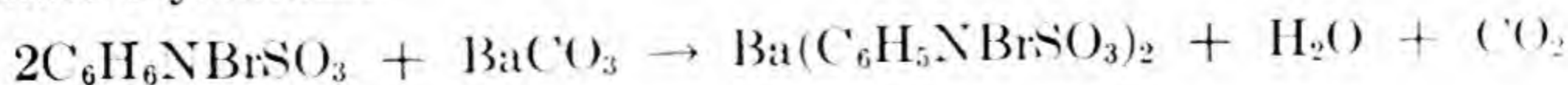


H. Hubner, *Ann.*, **222**, 181 (1884)

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**3-Amino-4-bromobenzenesulfonic acid****I-2103**

Excess solid barium carbonate is added to the acid, the solution filtered and concentrated. Crystals of barium 3-amino-4-bromobenzenesulfonate crystallize.



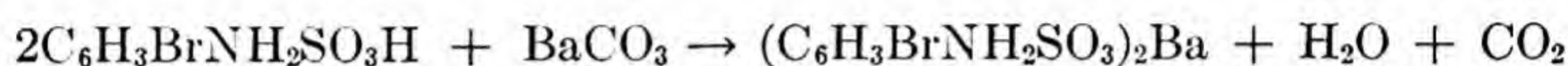
C. Goslich, *Ann.*, **180**, 101 (1876)

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**5-Amino-2-bromobenzenesulfonic acid****I-2104**

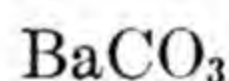
An aqueous solution of 5-amino-2-bromobenzenesulfonic acid is neutralized with barium carbonate and filtered. The solution is concentrated until crystals begin to form. Crystals of barium 5-amino-2-bromobenzenesulfonate with two H_2O separate.

A similar reaction occurs when this reagent is treated with lead carbonate, or silver carbonate. Both the lead and silver salts crystallize water-free.



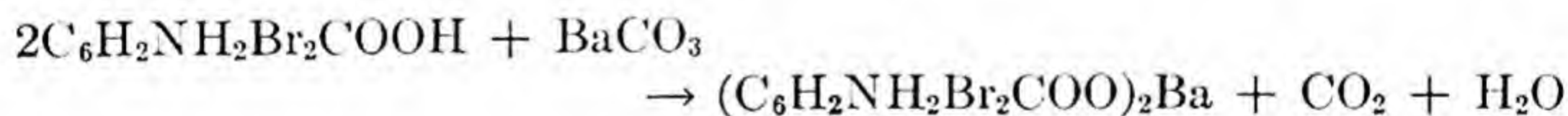
A. Bahlmann, *Ann.*, **186**, 319 (1877)

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**2-Amino-3,5-dibromobenzoic acid****I-2105**

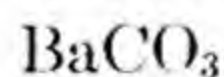
2-Amino-3,5-dibromobenzoic acid is dissolved in dilute hydrochloric acid and treated with an excess of barium carbonate. The solution is filtered and concentrated. Crystals of barium-2-amino-3,5-dibromobenzoate with four H_2O separate.

A similar reaction occurs when this reagent is treated with calcium carbonate. The calcium salt has four H_2O .



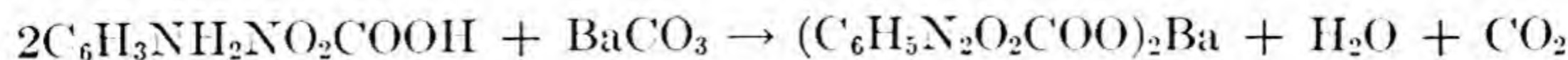
H. Hubner, *Ann.*, **222**, 176 (1884)

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**2-Amino-3-nitrobenzoic acid****I-2106**

An aqueous solution of 2-amino-3-nitrobenzoic acid is treated with an excess barium carbonate, the solution filtered and concentrated. Barium 2-amino-3-nitrobenzoate crystallizes with three H_2O .

A similar reaction occurs when this reagent is treated with calcium carbonate or potassium carbonate. The calcium salt crystallizes with three H_2O and the potassium salt with two H_2O .



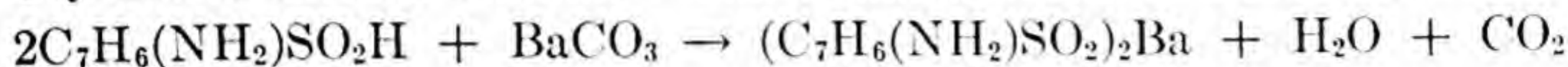
H. Hubner, *Ann.*, **195**, 22 (1879)

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**4-Amino-2-toluenesulfinic acid**

I-2107

4-Amino-2-toluenesulfinic acid is dissolved in water, warming if necessary, and the solution saturated with barium carbonate. The solution is filtered and concentrated to syrupy consistency and alcohol added. Crystals of barium 4-amino-2-toluenesulfinate with two H₂O separate.



H. Limpricht and A. Heffter, *Ann.*, **221**, 348 (1883)

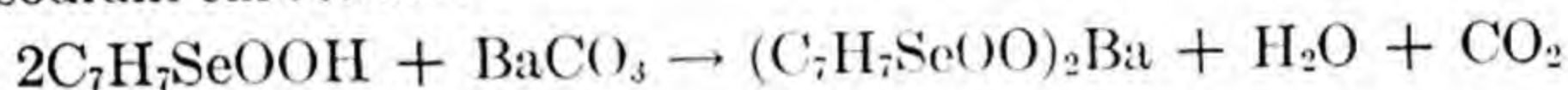
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**Benzylselenous acid**

I-2108

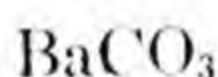
A hot aqueous solution of benzylselenous acid is treated with barium carbonate until the solution is neutral. The solution is filtered and concentrated. Crystals of barium benzylselenite precipitate.

The same type of reaction occurs when benzylselenous acid is treated with sodium carbonate.



C. Jackson, *Ann.*, **179**, 14 (1875)

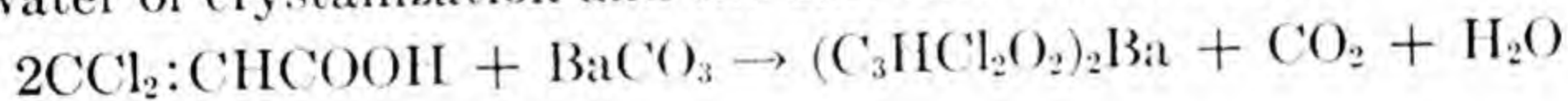
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**Betadichloroacrylic acid**

I-2109

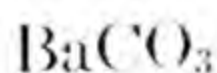
Betadichloroacrylic acid is neutralized with barium carbonate, the solution filtered and concentrated. Barium betadichloroacrylate with five H₂O crystallizes from the solution.

A similar reaction occurs when betadichloroacrylic acid is treated with potassium carbonate or zinc carbonate. The potassium salt contains no water of crystallization and the zinc salt has two H₂O.



O. Wallach, *Ann.*, **193**, 23 (1878)

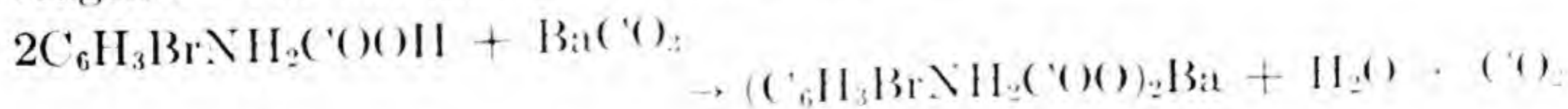
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**3-Bromo-5-aminobenzoic acid**

I-2110

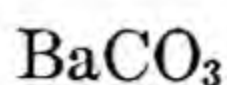
An aqueous suspension of 3-bromo-5-aminobenzoic acid is treated with barium carbonate until saturated. The solution is filtered and concentrated. Crystals of barium-3-bromo-5-aminobenzoate with four H₂O separate.

A similar reaction occurs when calcium carbonate is treated with this reagent. The calcium salt has five and one half H₂O.

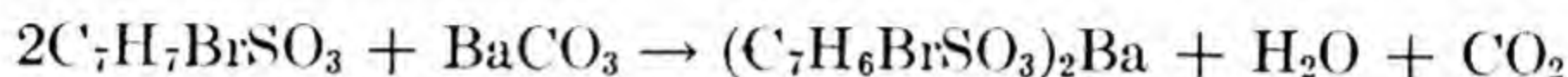


H. Hubner, *Ann.*, **222**, 170 (1884)

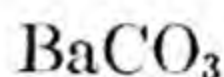
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**3-Bromo-2-toluenesulfonic acid****I-2111**

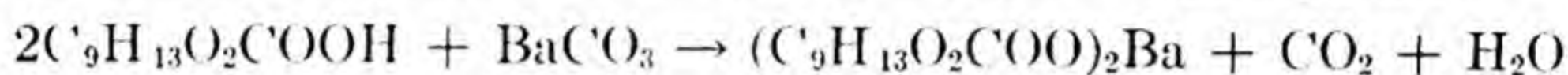
An aqueous solution of 3-bromo-2-toluenesulfonic acid is heated with an excess of barium carbonate for a long time, the solution filtered and concentrated. Crystals of barium-3-bromo-2-toluenesulfonate separate with one H_2O . The same type of reaction occurs when lead carbonate is treated with 3-bromo-2-toluenesulfonic acid. The lead salt crystallizes with three H_2O .

E. Grete, *Ann.*, **177**, 232 (1875)

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**Camphanic acid****I-2112**

Camphanic acid is saturated with barium carbonate and filtered. Crystals of barium camphanate with three and one half H_2O separate.

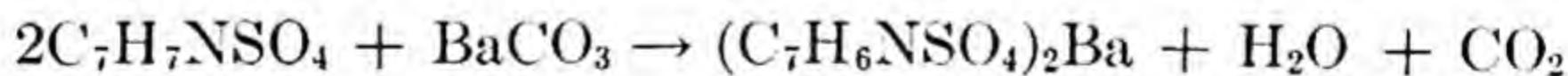
R. Fittig, *Ann.*, **227**, 5 (1885)

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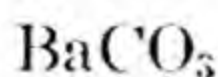
**1-Carboxy-4-benzenesulfonamide****I-2113**

An aqueous solution of 1-carboxy-4-benzenesulfonamide is heated with an excess of barium carbonate, filtered and concentrated. Barium 4-benzenesulfonamide-1-carboxylate crystallizes with one H_2O .

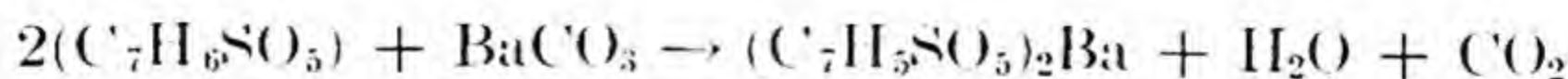
A similar reaction occurs when 1-carboxy-4-benzenesulfonamide is treated with NH_4OH .

I. Remsen, *Ann.*, **178**, 302 (1875)

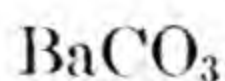
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**1-Carboxy-4-benzenesulfonic acid****I-2114**

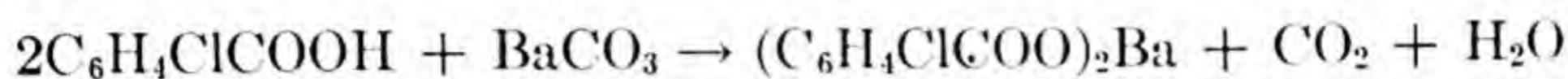
An aqueous solution of 1-carboxy-4-benzenesulfonic acid is divided into two equal parts. One part is neutralized with barium carbonate and filtered. The other part of the original acid solution is now added and the resulting solution concentrated on the water bath until crystallization starts. Crystals of barium-1-carboxy-4-benzenesulfonate separate with three H_2O .

I. Remsen, *Ann.*, **178**, 285 (1875)

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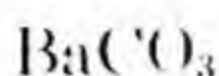
**2-Chlorobenzoic acid****I-2115**

2-Chlorobenzoic acid is dissolved in hot water and an excess of barium carbonate added. The solution is filtered and concentrated. Crystals of barium-2-chlorobenzoate with three H_2O separate.

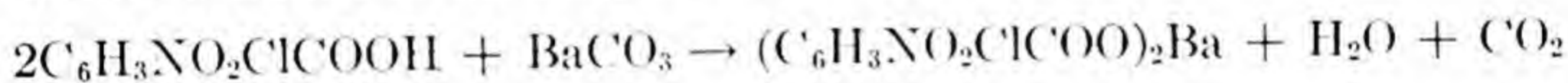


H. Hubner, F. Wilkens and G. Rack, *Ann.*, **222**, 192 (1884)

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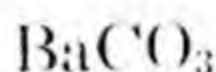
**3-Chloro-5-nitrobenzoic acid****I-2116**

3-Chloro-5-nitrobenzoic acid is added to water and heated while barium carbonate is added until an excess remains. The solution is filtered and concentrated. Crystals of barium-3-chloro-5-nitrobenzoate with four H_2O separate. The same type reaction takes place when lead acetate is added to the reagent and to its sodium salt.

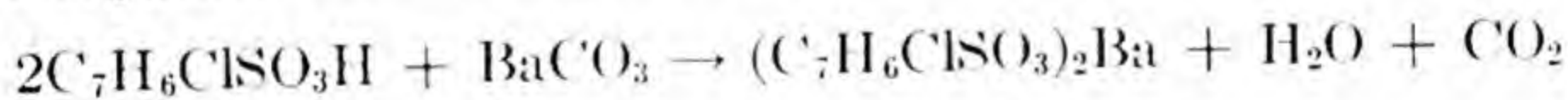


H. Hubner, *Ann.*, **222**, 89 (1884)

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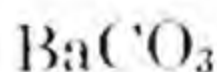
**2-Chloro-p-toluenesulfonic acid****I-2117**

2-Chloro-p-toluenesulfonic acid is neutralized with barium carbonate, filtered and concentrated. Crystals of barium-2-chloro-p-toluenesulfonate separate with no water of crystallization.

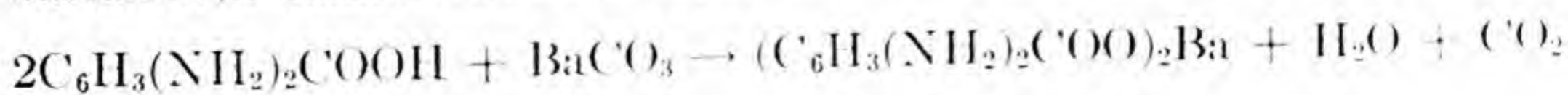


H. Limpricht and W. Paysan, *Ann.*, **221**, 212 (1883)

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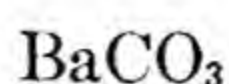
**3,5-Diaminobenzoic acid****I-2118**

3,5-Diaminobenzoic acid is saturated with barium carbonate in an aqueous suspension, the solution filtered and concentrated. Crystals of barium-3,5-diaminobenzoate with one and one half H_2O separate.

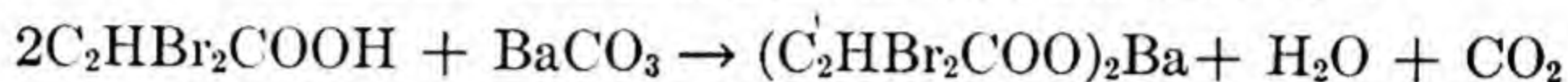


H. Hubner, *Ann.*, **222**, 86 (1884)

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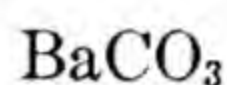
**Dibromoacrylic acid****I-2119**

A warm solution of dibromoacrylic acid is neutralized with barium carbonate, the solution filtered and concentrated. Upon cooling, crystals of barium dibromoacrylate precipitate with two and one half H_2O . A similar reaction occurs when this reagent is treated with calcium carbonate and the calcium salt contains two and one half H_2O .



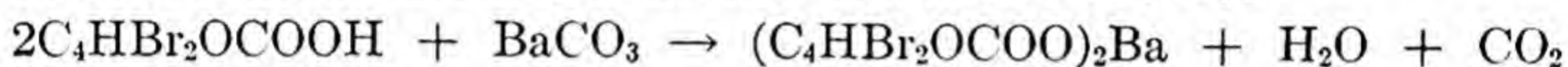
Fittig and Petri, *Ann.*, **195**, 71 (1879)

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**3,5-Dibromo-alpha-furoic acid****I-2120**

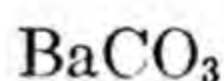
A boiling aqueous solution of 3,5-dibromo-alpha-furoic acid is treated with barium carbonate, the solution filtered and cooled. Crystals of barium 3,5-dibromofuroate with four H_2O separate.

A similar reaction occurs when this reagent is treated with calcium carbonate, silver nitrate, sodium carbonate or potassium carbonate. The calcium salt has three H_2O and the sodium salt two H_2O .

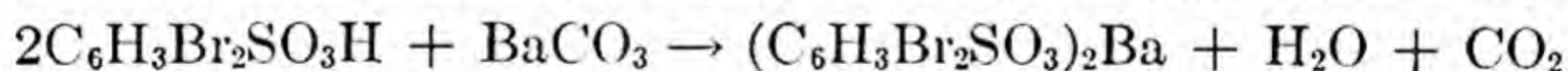


H. Hill and C. Sanger, *Ann.*, **232**, 74-7 (1886)

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**3,6-Dibromobenzenesulfonate****I-2121**

3,6-Dibromobenzenesulfonic acid is dissolved in water and neutralized with barium carbonate, filtered and allowed to crystallize. Barium 3,6-dibromobenzenesulfonate separates with one and one half H_2O .



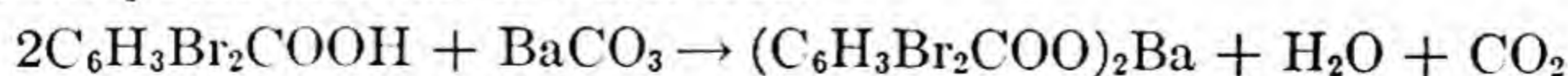
H. Limpricht, *Ann.*, **186**, 139 (1877)

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**3,4-Dibromobenzoic acid****I-2122**

3,4-Dibromobenzoic acid is suspended in hot water and an excess of barium carbonate added, the solution filtered and concentrated. Crystals of barium-3,4-dibromobenzoate with four H_2O separate.

A similar reaction occurs when this reagent is treated with strontium carbonate or potassium carbonate. The strontium salt has four H_2O , and the potassium salt is water-free.

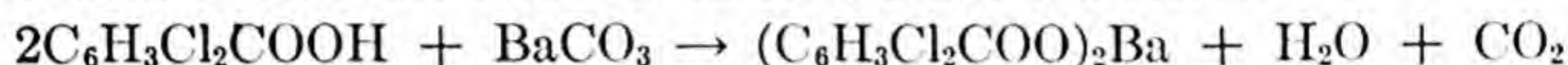


H. Hubner, *Ann.*, **222**, 185 (1884)

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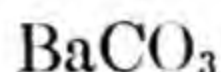
**2,4-Dichlorobenzoic acid****I-2123**

A hot aqueous solution of 2,4-dichlorobenzoic acid is neutralized with barium carbonate, the residue filtered, washed and dried. It is barium 2,4-dichlorobenzoate and has three and one half H_2O .

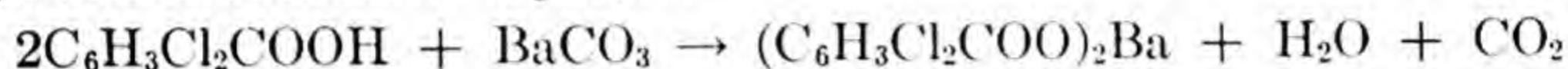


E. Lellmann and C. Klatz, *Ann.*, **231**, 316 (1885)

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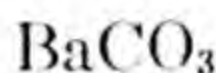
**2,5-Dichlorobenzoic acid****I-2124**

An aqueous solution of 2,5-dichlorobenzoic acid is digested with barium carbonate, the solution filtered and cooled. Crystals of barium 2,5-dichlorobenzoate separate.



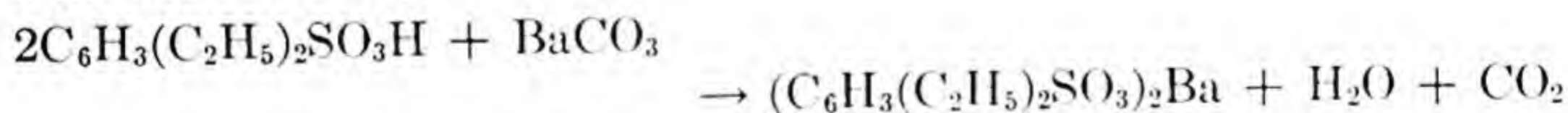
E. Lellmann and C. Klatz, *Ann.*, **231**, 319 (1885)

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**p-Diethylbenzolsulfonic acid****I-2125**

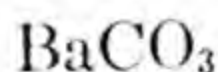
Pure free p-diethylbenzolsulfonic acid is heated with an excess of barium carbonate, filtered and concentrated. Crystals of barium p-diethylbenzolsulfonate with four H_2O separate.

A similar reaction occurs when this reagent is treated with lead carbonate, silver oxide, strontium carbonate, calcium carbonate, mercuric oxide, nickel carbonate, or cobalt carbonate. The lead salt crystallizes with three H_2O , the silver with none, the strontium with four, the calcium with five, the mercuric with none, the nickel with five and the cobalt with five H_2O .



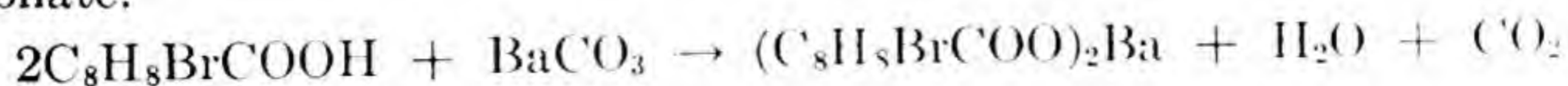
H. Aschenbrandt, *Ann.*, **216**, 215 (1883)

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**2,4-Dimethyl-5-bromobenzoic acid****I-2126**

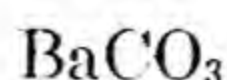
2,4-Dimethyl-5-bromobenzoic acid is digested with an excess barium carbonate, filtered and cooled. Barium 2,4-dimethyl-5-bromobenzoate crystallizes out with four H_2O .

A similar reaction occurs when this reagent is treated with calcium carbonate.

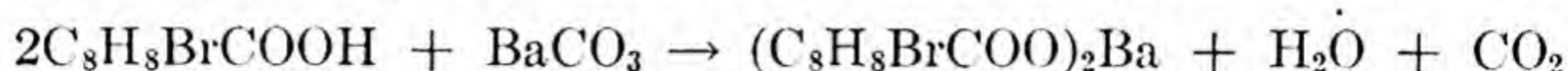


H. Schnitz, *Ann.*, **193**, 173 (1878)

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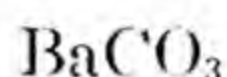
**3,5-Dimethyl-4-bromobenzoic acid****I-2127**

3,5-Dimethyl-4-bromobenzoic acid is digested with an excess barium carbonate, filtered and cooled. Crystals of barium 3,5-dimethyl-4-bromobenzoate separate out with no water of crystallization.



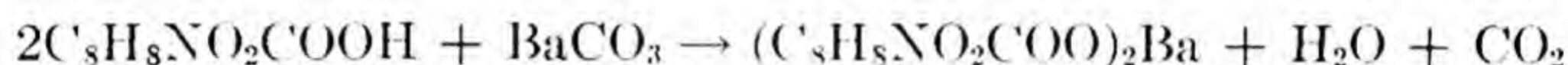
H. Schnitz, *Ann.*, **193**, 175 (1878)

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**1,3-Dimethyl-2-nitrobenzoic acid****I-2128**

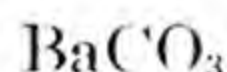
1,3-Dimethyl-2-nitrobenzoic acid is digested with an excess barium carbonate, filtered and cooled. Crystals of barium 1,3-dimethyl-2-nitrobenzoate with four H_2O separate from the solution.

A similar reaction occurs when this reagent is treated with calcium carbonate.



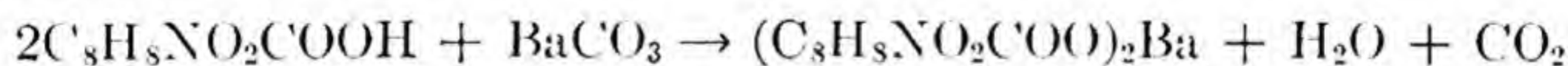
H. Schnitz, *Ann.*, **193**, 168 (1878)

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**2,4-Dimethyl-5-nitrobenzoic acid****I-2129**

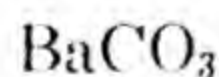
2,4-Dimethyl-5-nitrobenzoic acid is digested for a long time with an excess of barium carbonate. The solution is filtered and cooled. Barium 2,4-dimethyl-5-nitrobenzoate crystallizes out with four H_2O .

A similar reaction occurs when this reagent is treated with calcium carbonate.

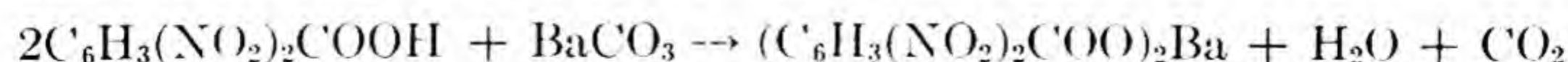


H. Schnitz, *Ann.*, **193**, 168-9 (1878)

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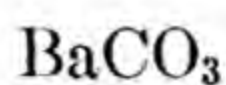
**2,4-Dinitrobenzoic acid****I-2130**

An aqueous suspension of 2,4-dinitrobenzoic acid is treated with barium carbonate until saturated. The solution is filtered, concentrated and allowed to crystallize. Barium-2,4-dinitrobenzoate crystallizes with three H_2O . A similar reaction occurs when this reagent is treated with calcium carbonate or magnesium carbonate. The calcium salt has two and one half H_2O and the magnesium salt nine.



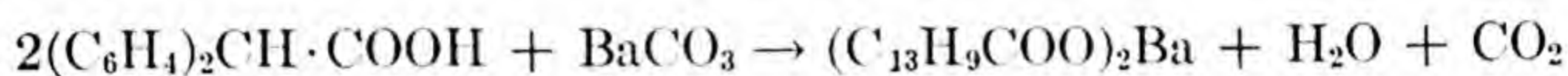
H. Hubner, *Ann.*, **222**, 80-1 (1884)

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**Diphenyleneacetic acid****I-2131**

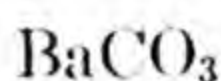
A very dilute, hot aqueous solution of diphenyleneacetic acid is neutralized with barium carbonate, filtered and allowed to cool. Crystals of barium diphenyleneacetate with three H₂O separate.

A similar reaction occurs when this reagent is treated with calcium carbonate. The calcium salt crystallizes with two and one half H₂O.

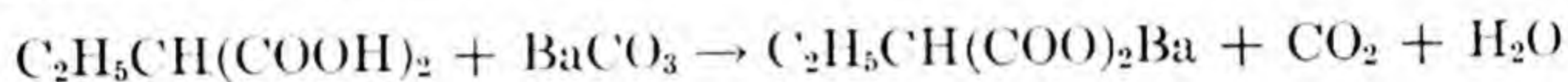


R. Fittig and H. Liepmann, *Ann.*, **200**, 14-5 (1880)

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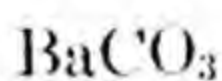
**Ethylmalonic acid****I-2132**

An aqueous solution of ethylmalonic acid is treated with excess dry barium carbonate, filtered and concentrated. Crystals of barium ethyl malonate precipitate.

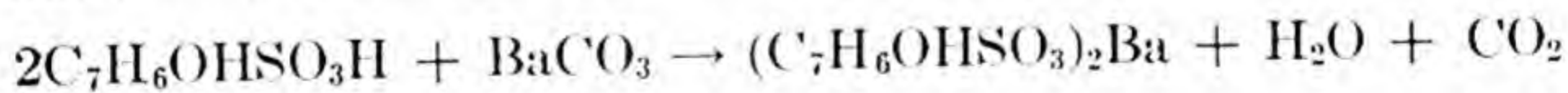


A. Tupoleff, *Ann.*, **171**, 246 (1874)

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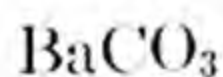
**p-Hydroxybenzylsulfonic acid****I-2133**

A hot aqueous solution of p-hydroxybenzylsulfonic acid is neutralized with barium carbonate, filtered and concentrated. Alcohol is added to the concentrated solution and crystals of barium-p-hydroxybenzyl-sulfonate with seven and one half H₂O separate.

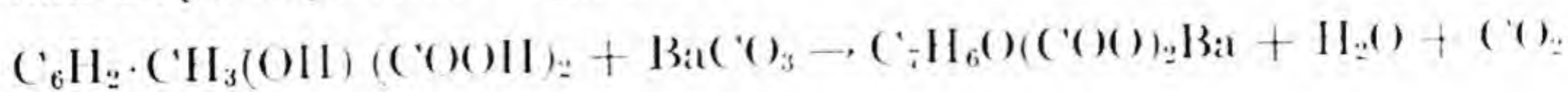


G. Mohr, *Ann.*, **221**, 221 (1883)

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**4-Hydroxyuvitic acid****I-2134**

4-Hydroxyuvitic acid is treated with an excess of barium carbonate, the solution filtered and concentrated to a small volume. Crystals of barium 4-hydroxyuvitate separate.

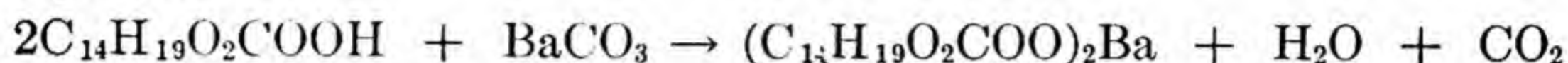


O. Jacobson, *Ann.*, **195**, 288 (1879)

20

**Isobutylphenoxypivalinic acid****I-2135**

A hot aqueous solution of isobutylphenoxypivalinic acid is diluted with water and neutralized with barium carbonate, filtered and concentrated. Crystals of barium isobutylphenoxypivalinate with two H₂O separate.

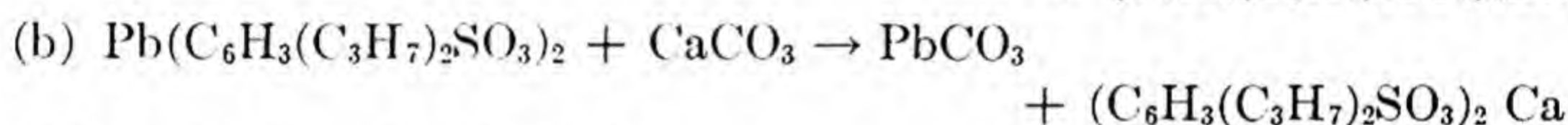
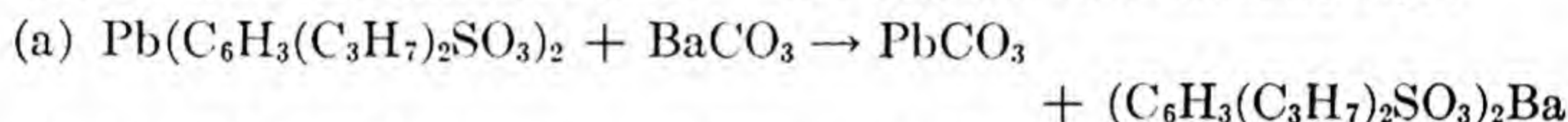


R. Fittig, *Ann.*, **227**, 64 (1885)

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**Lead p-di-n-propylbenzolsulfonate****I-2136**

Lead p-di-n-propylbenzolsulfonate is dissolved in water and heated during the addition of barium carbonate. The solution is filtered and concentrated. Crystals of barium p-di-n-propylbenzolsulfonate with one half H₂O separate. A similar reaction occurs when this reagent is treated with calcium carbonate. The calcium salt has nine H₂O.

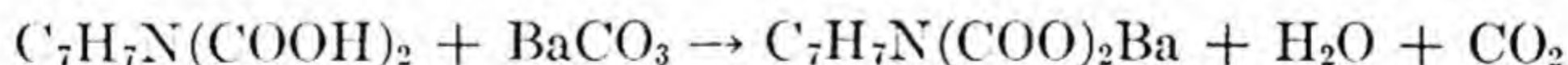


H. Korner, *Ann.*, **216**, 225 (1883)

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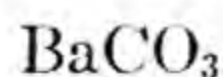
**Lutidine dicarboxylic acid****I-2137**

A hot saturated aqueous solution of lutidine dicarboxylic acid is neutralized with barium carbonate, the solution filtered and concentrated. Crystals of barium lutidine dicarboxylate with two H₂O separate.



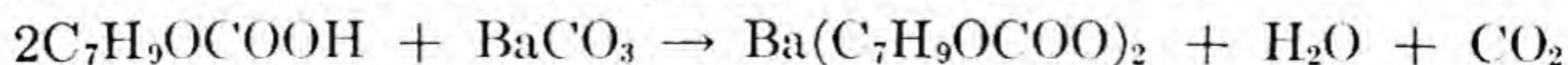
F. Engelmann, *Ann.*, **231**, 53 (1885)

20

**Methyluvinic acid****I-2138**

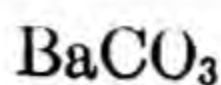
A warm aqueous solution of methyluvinic acid is digested with an excess of barium carbonate, filtered and cooled. Crystals of barium methyluvinate separate with four H₂O.

A similar reaction occurs when this reagent is treated with calcium carbonate. The calcium salt separates with four H₂O.



R. Fittig, *Ann.*, **250**, 206 (1889)

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**3-Nitro-5-aminobenzoic acid****I-2139**

3-Nitro-5-aminobenzoic acid is saturated with barium carbonate, the solution filtered and concentrated. Upon cooling, crystals of barium-3-nitro-5-aminobenzoate with four H_2O separate. A similar reaction occurs when this reagent is treated with calcium carbonate or lead carbonate. The calcium salt has five and one half H_2O , and the lead salt three and one half.

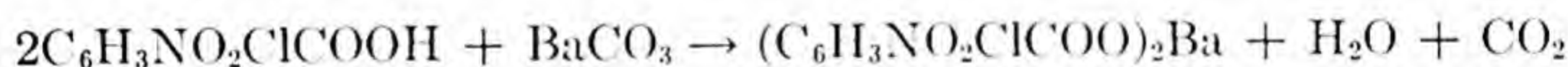
H. Hubner, Ann., **222**, 83 (1884)

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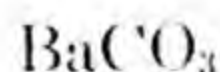
**3-Nitro-4-chlorobenzoic acid****I-2140**

3-Nitro-4-chlorobenzoic acid is suspended in water and warmed. Barium carbonate is added until an excess remains, the solution filtered and concentrated. Upon cooling, crystals of barium-3-nitro-4-chlorobenzoate with four H_2O separate.

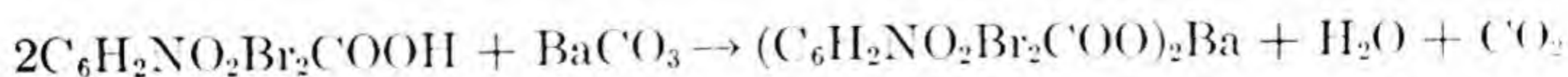
A similar reaction occurs when this reagent is treated with calcium carbonate. The calcium salt has five and one half H_2O .

H. Hubner, Ann., **222**, 182 (1884)

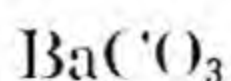
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**2-Nitro-3,4-dibromobenzoic acid****I-2141**

2-Nitro-3,4-dibromobenzoic acid is added to hot water and an excess of barium carbonate added, the solution filtered and concentrated. Crystals of barium-2-nitro-3,4,-dibromobenzoate with one H_2O separate. A similar reaction occurs when this reagent is treated with calcium carbonate. The calcium salt has three and one half H_2O .

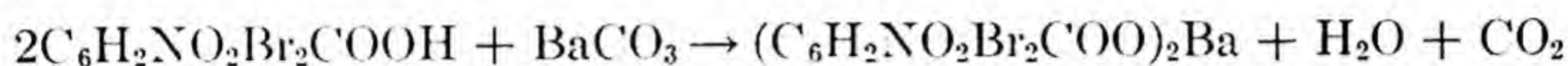
H. Hubner and E. Smith, Ann., **222**, 188 (1884)

20

**2-Nitro-3,5-dibromobenzoic acid****I-2142**

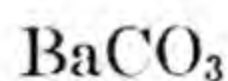
2-Nitro-3,5-dibromo-benzoic acid is dissolved in hot water and treated with barium carbonate. The solution is filtered and concentrated. Crystals of barium-2-nitro-3,5-dibromo-benzoate with four H₂O separate.

A similar reaction occurs when this reagent is treated with calcium carbonate. The calcium salt is water free.

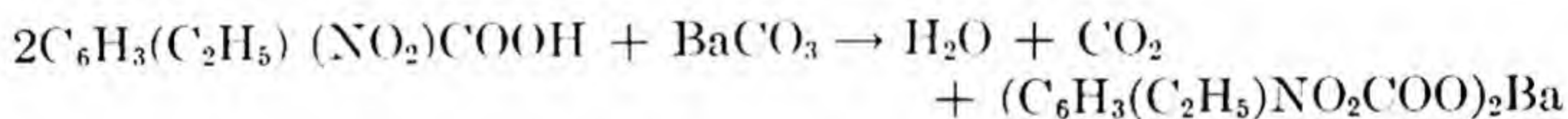


H. Hubner, Ann., **222**, 174 (1884)

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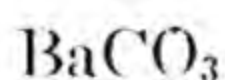
**2-Nitro-4-ethyl benzoic acid****I-2143**

2-Nitro-4-ethyl benzoic acid is heated and treated with an excess of barium carbonate for several hours, filtered and cooled. Crystals of barium orthonitrobenzoate with four H₂O separate. A similar reaction occurs when this reagent is treated with calcium carbonate, strontium carbonate or potassium carbonate. The calcium salt has two H₂O, the strontium four and the potassium is water-free.



H. Aschenbrandt, Ann., **216**, 221-2 (1883)

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**2-Nitro-5-n-propylbenzoic acid****I-2144**

2-Nitro-5-n-propylbenzoic acid is digested hot with an excess of barium carbonate until no more carbon dioxide is evolved, filtered, concentrated and cooled. Crystals of barium-2-nitro-5-n-propylbenzoate with four H₂O separate.

A similar reaction occurs when this reagent is treated with strontium carbonate. The strontium salt has five H₂O.

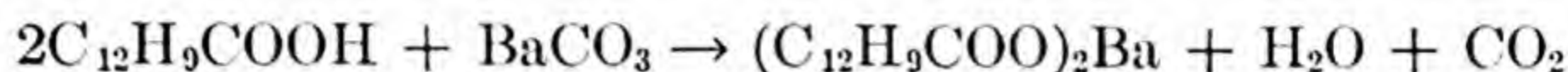


H. Korner, Ann., **216**, 231 (1883)

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**Orthophenylbenzoic acid****I-2145**

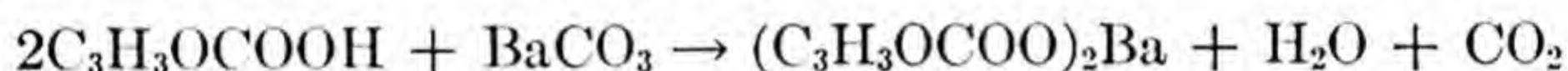
An aqueous solution of orthophenylbenzoic acid is neutralized with barium carbonate and filtered. The filtrate is concentrated until crystals begin to form. Barium orthophenylbenzoate crystallizes with one H₂O.

A. Schmitz, *Ann.*, **193**, 121 (1878)

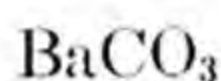
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**Oxytetrollic acid****I-2146**

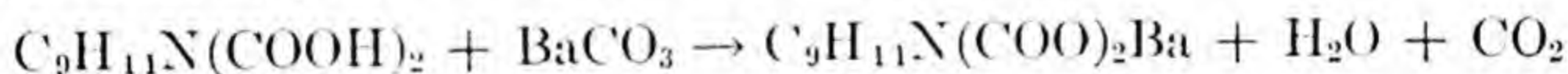
A hot aqueous solution of oxytetrollic acid is digested with excess barium carbonate, the solution filtered and cooled. Crystals of barium oxytetrolate with five H₂O separate.

C. Duisberg, *Ann.*, **213**, 161 (1882)

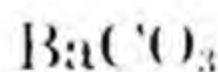
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**Parvolin dicarboxylic acid****I-2147**

A hot aqueous solution of parvolin dicarboxylic acid is saturated with barium carbonate, the solution filtered and concentrated. Barium parvolin dicarboxylate with three H₂O precipitates.

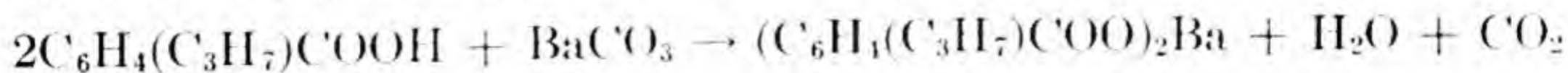
F. Engelmann, *Ann.*, **231**, 43 (1885)

20

**p-n-Propylbenzoic acid****I-2148**

Para-n-propylbenzoic acid is neutralized with an excess of barium carbonate, filtered, concentrated and cooled. Crystals of barium p-n-propylbenzoate with two H₂O separate.

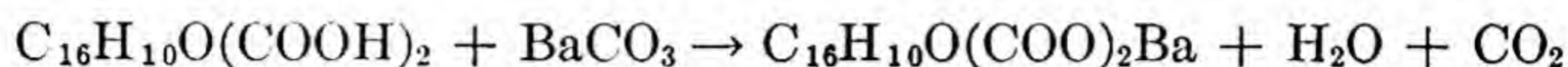
A similar reaction occurs when this reagent is treated with calcium carbonate, strontium carbonate or lead carbonate. The calcium salt has three H₂O, the strontium two and one half and the lead two H₂O.

H. Korner, *Ann.*, **216**, 220 (1883)

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**Pulvinic acid****I-2149**

A hot aqueous solution of pulvinic acid is treated with excess barium carbonate, filtered and the residue dried. Barium pulvinate results.

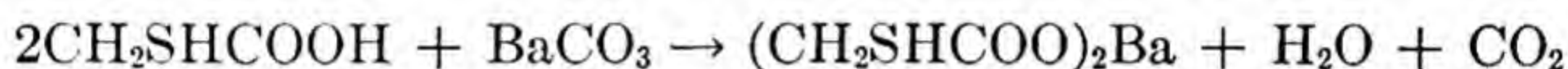


A. Spiegel, *Ann.*, **219**, 9 (1883)

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**Thioglycollic acid****I-2150**

An aqueous solution of thioglycollic acid is heated with an excess of barium carbonate, filtered and alcohol added to the filtrate until a persistent turbidity results. Crystals of barium thioglycollate separate.

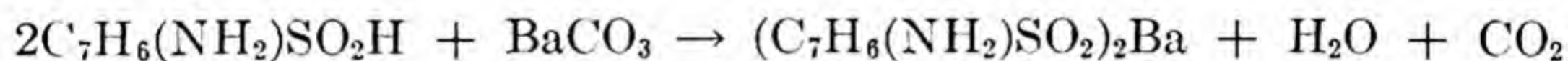


C. Liebermann, *Ann.*, **207**, 124 (1881)

20

**p-Toluidine-2-sulfinic acid****I-2151**

p-Toluidine-2-sulfinic acid is saturated with barium carbonate, filtered and concentrated to a syrupy consistency. Upon cooling crystals of barium-p-toluidine-sulfinic acid with two H_2O separate.



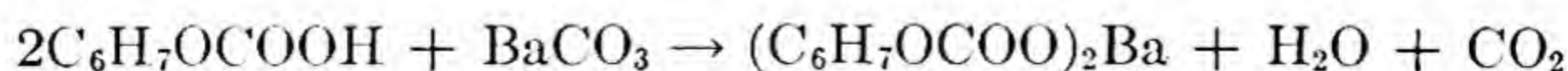
H. Limpricht and A. Heffter, *Ann.*, **221**, 348 (1883)

20

**Uvinic acid****I-2152**

A hot aqueous solution of uvinic acid is neutralized with barium carbonate, filtered and cooled. Crystals of barium uvinate separate with four H_2O .

A similar reaction occurs when this reagent is treated with calcium carbonate. The calcium salt separates with two H_2O .



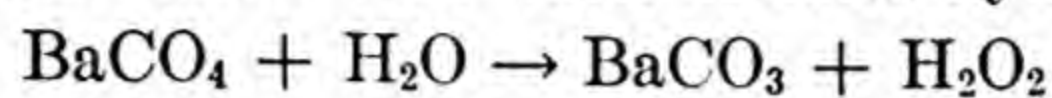
R. Fittig, *Ann.*, **250**, 192-3 (1889)

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H₂O

I-2153

Barium percarbonate reacts with water to form hydrogen peroxide.



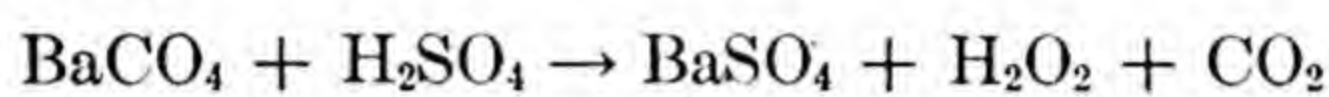
Merck, Ger. Pat. 179826 (1905)

25

H₂SO₄

● I-2154

Barium percarbonate reacts with cold dilute sulfuric acid, forming hydrogen peroxide.



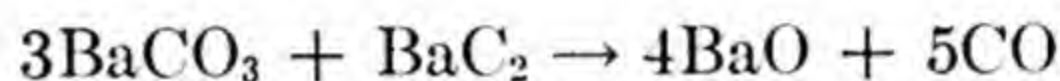
Merck, Ger. Pat. 179826 (1905)

25

BaCO₃

I-2155

The reaction of barium carbonate and barium carbide when mixed and heated is:



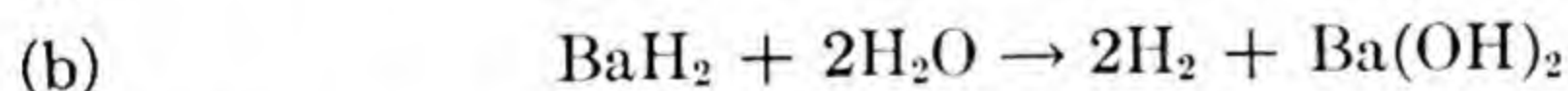
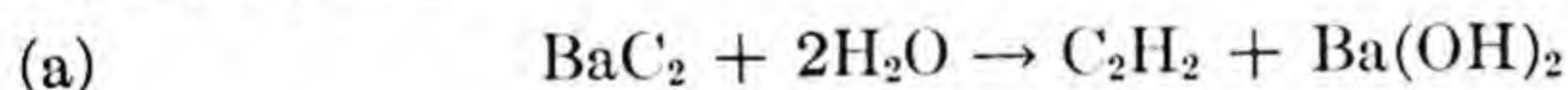
T. H. Norton, J. Ind. Eng. Chem., **5**, 703 (1913)

22

H₂O

I-2156

Barium carbide when treated with water at room temperature forms acetylene and hydrogen. The hydrogen is probably formed from barium hydride.



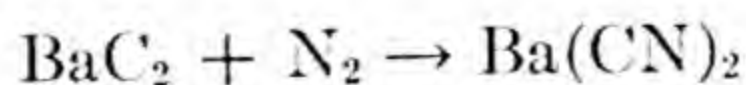
Franz Fischer, Brennstoff-Chem., **9**, 333 (1928)

11

N₂

I-2157

Barium cyanide results when barium carbide reacts with nitrogen at a high temperature.



H. G. Söderbaum, Sv. Kem. Tidskr., **15**, 124 (1903)

10

Ref., Erlwein, Electrochem., **9**, 842 (1903)

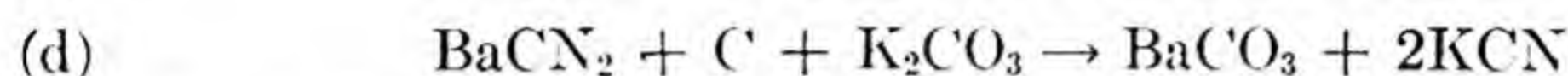
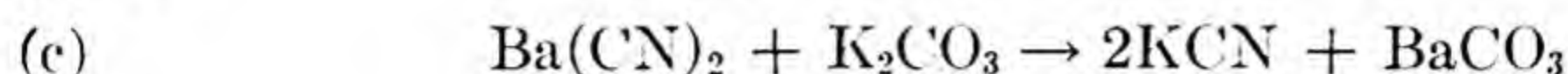
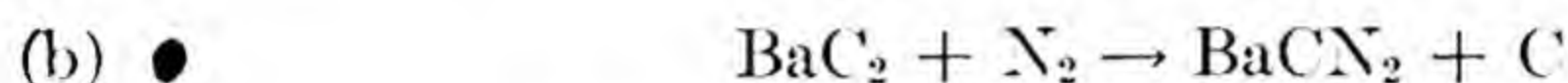
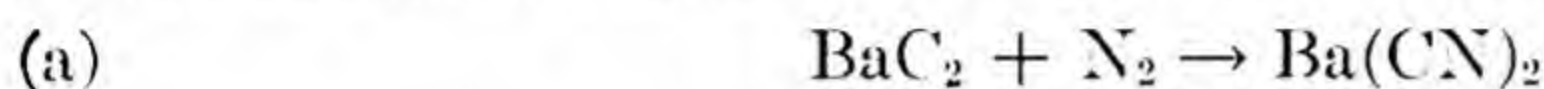
25

Ref., Frank, J. Am. Chem. Soc., **28**, 1250 (1906)

1

BaC₂**N₂****I-2158**

Barium carbide absorbs nitrogen with avidity at a temperature between 700 and 800°C, forming barium cyanide and barium cyanamide in a proportion of about two to three. The fusion mixture is readily transformed to soluble cyanide with a potash or soda flux.



A. R. Frank, *Trans. Far. Soc.*, **4**, 103 (1908)

85

Ref., E. H. Pranke, *J. Ind. Eng. Chem.*, **5**, 159 (1913)

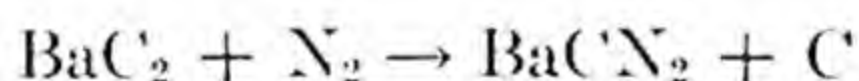
22

Ref., Frantz Fischer, *Brennstoff-Chem.*, **9**, 331 (1928)

11

BaC₂**N₂****I-2159**

Barium carbide is heated to a bright red temperature in a stream of nitrogen.

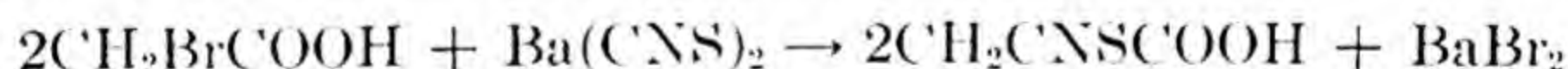


Frank and Caro, *Ger. Pat.* 108971 (1898)

25

Ba(CNS)₂**CH₂BrCOOH****I-2160**

The reaction between barium thiocyanate and bromoacetic acid is of the second order in acetone solution.

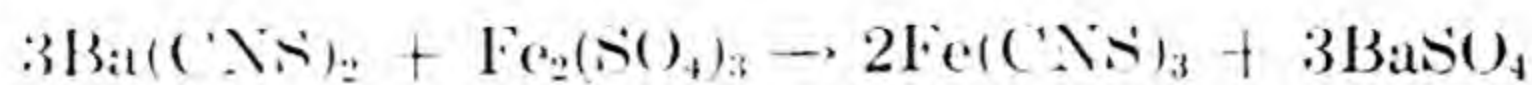


H. Demierre and M. Duboux, *J. Chim. phys.*, **5**, 340, (1907)

69

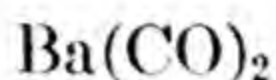
Ba(CNS)₂**Fe₂(SO₄)₃****I-2161**

Crystals of ferric thiocyanate are formed when equivalent quantities of solutions of barium thiocyanate and ferric sulfate are mixed, the precipitate filtered and the solution allowed to crystallize in a brown desiccator.



Schlesinger and Van Valkenburgh, *J. Am. Chem. Soc.*, **53**, 1215 (1931)

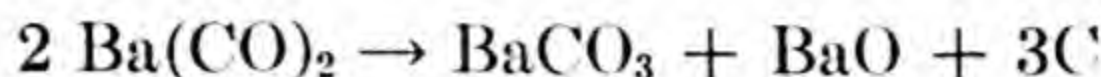
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Δ /

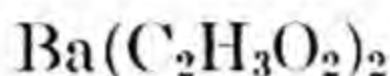
I-2162

Barium carbonyl is ignited strongly in air, yielding the products shown below.



Guntz and Mentrel, *Bull. Soc. Chim.* [3] **29**, 586 (1903)

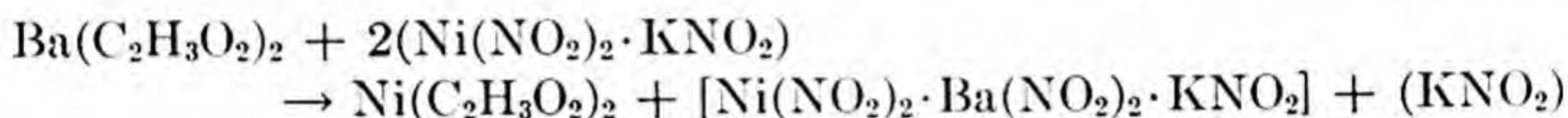
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Ni(NO₂)₂·KNO₂

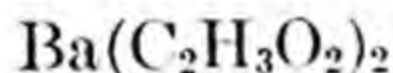
I-2163

When solutions of barium acetate and nickel potassium nitrite are mixed the triple nitrite of nickel, barium and potassium separates.



J. Lang, *K. Sv. Vet. Akad. Handl.*, **3**, 22 (1860)

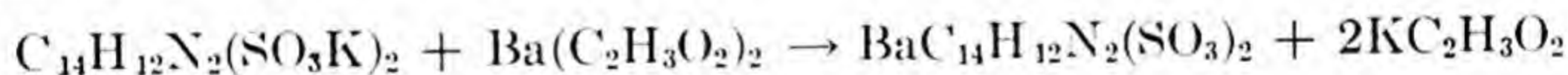
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Dipotassium-p-azobenzyldisulfonate

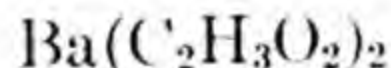
I-2164

An aqueous solution of dipotassium-p-azobenzyldisulfonate is treated with an aqueous solution of barium acetate, and the solution concentrated. Crystals of barium-p-azobenzyl disulfonate with one and one half H₂O separate.



G. Mohr, *Ann.*, **221**, 224 (1883)

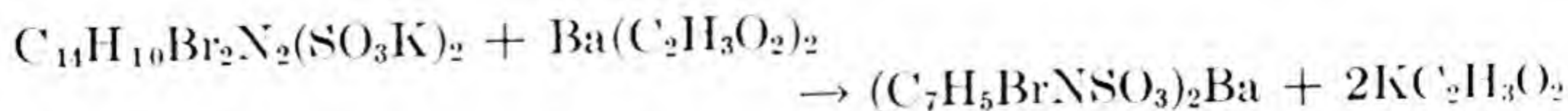
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Dipotassium-3-3-dibromo 2-2-dimethyl-4-4-azo-benzoldisulfonate

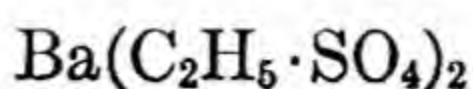
I-2165

A hot aqueous solution of dipotassium 3-3-dibromo-2-2-dimethyl-4-4-azobenzoldisulfonate is treated with an aqueous solution of barium acetate. The solution is filtered and cooled. Crystals of barium-3-3-dibromo-2-2-dimethyl-4-4-azobenzoldisulfonate with five water separate.

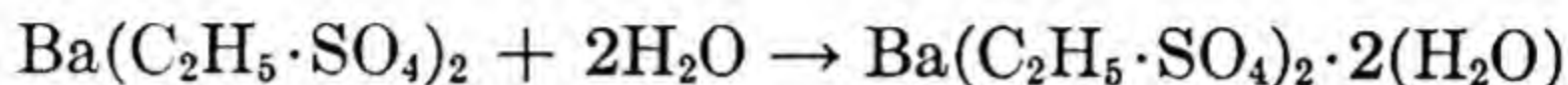


O. Kornatzki, *Ann.*, **221**, 186 (1883)

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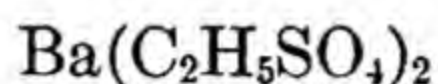
**H₂O****I-2166**

Evaporation of a solution of barium ethyl sulfate yields large, well-formed, stable, transparent rhombic tablets of di-hydrated barium ethyl sulfate.

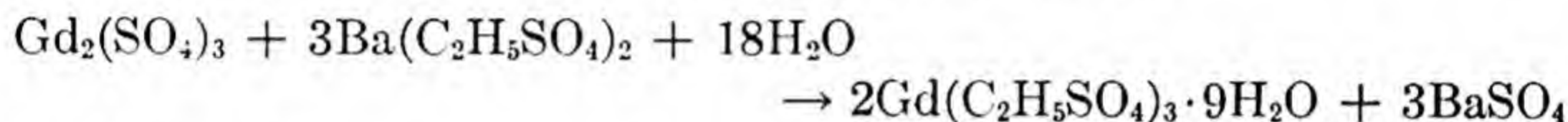


J. E. Alèn, K. Sv. Vet. Akad. Handl. Öfvers., **37**, No. 8, 30 (1880)

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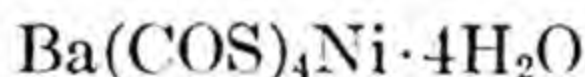
**Gd₂(SO₄)₃****I-2167**

Gadolinium ethyl sulfate is produced by double decomposition between barium ethyl sulfate and gadolinium sulfate.

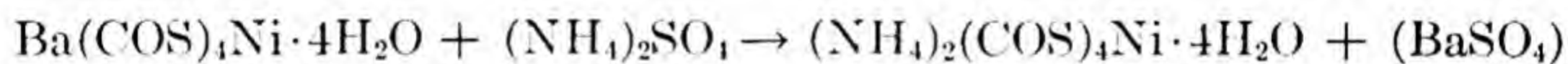


Spedding and Nutting, J. Am. Chem. Soc., **55**, 499 (1933)

1

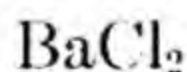
**(NH₄)₂SO₄****I-2168**

Ammonium nickelodithio-oxalate is prepared by mixing hot concentrated solutions of barium nickelodithio-oxalate and ammonium sulfate.

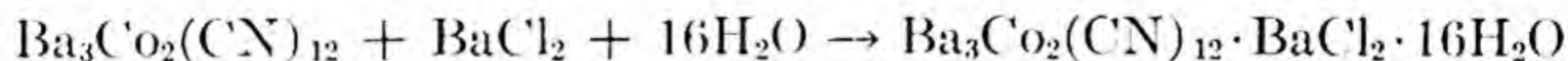


C. S. Robinson and H. O. Jones, J. Chem. Soc., (London), **101**, 66 (1912)

57.

**Ba₃Co₂(CN)₁₂****I-2169**

When solutions of barium chloride and barium cobalticyanide are mixed, a double salt is formed.

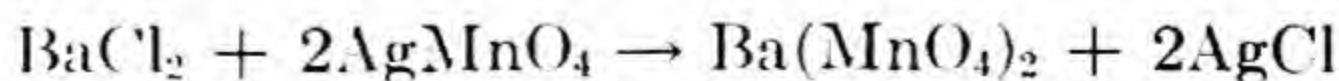


P. Weselsky, Ber. **2**, 596 (1669)

11

**AgMnO₄****I-2170**

A solution of barium chloride reacts with silver permanganate.



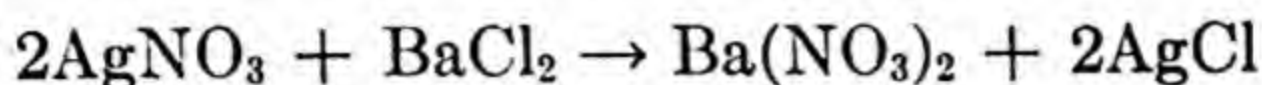
Crespi and Moles, Anales Soc. Espan fis quim, **20**, 692 (1922)

25

AgNO₃

I-2171

Barium nitrate and silver chloride are formed by the double decomposition of silver nitrate and barium chloride.



P. C. Rây, J. Chem. Soc. (London), **87**, 177 (1905)

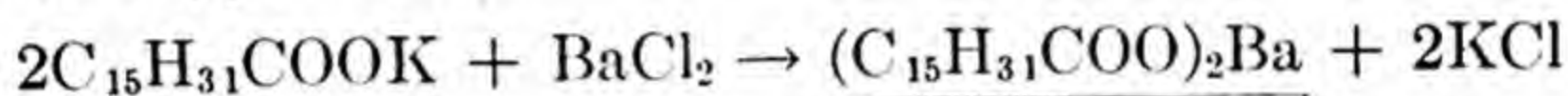
102

C₁₅H₃₁COOK

I-2172

An aqueous solution of potassium-diheptylacetate is treated with an aqueous solution of barium chloride as long as a precipitate forms. This precipitate, which is barium diheptylacetate, is filtered off, washed with water and warm alcohol and then dried.

A similar reaction occurs when this reagent is treated with magnesium chloride or copper sulfate.



F. Jourdan, Ann., **200**, 118-9 (1880)

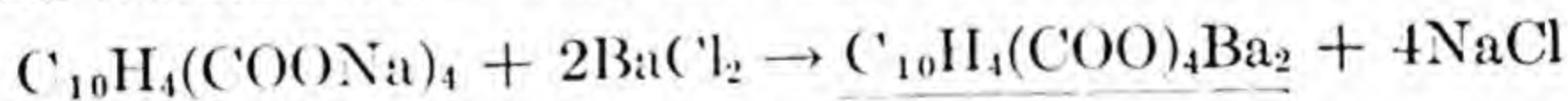
20

C₁₀H₄(COONa)₄

I-2173

An aqueous solution of sodium naphthalene 1,4,5,8-tetracarboxylate is treated with an aqueous solution of barium chloride as long as a precipitate forms. Filter off, wash with water and dry. The precipitate is barium naphthalene, 1,4,5,8-tetracarboxylate.

A similar reaction occurs when this reagent is treated with silver nitrate.



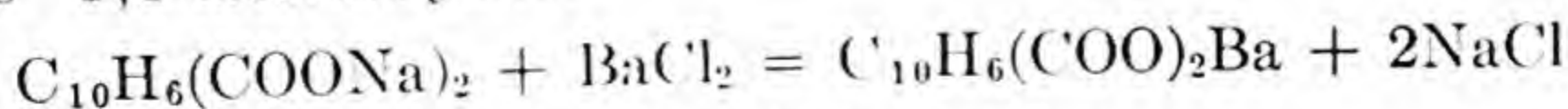
O. Bamberger and A. Philip, Ann., **240**, 184 (1887)

20

C₁₀H₆(COONa)₂

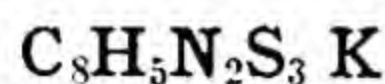
I-2174

An aqueous solution of sodium naphthalene 1,8-dicarboxylate is treated with an aqueous solution of barium chloride as long as a precipitate forms. Filter, wash and dry. The precipitate is barium naphthalene 1,8-dicarboxylate.



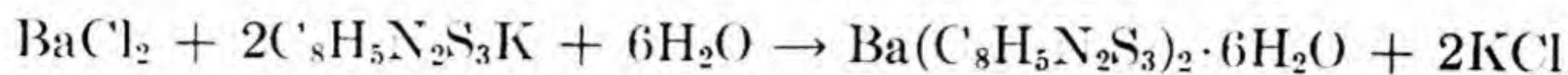
E. Bamberger and M. Philip, Ann., **240**, 181 (1887)

20



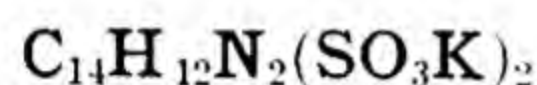
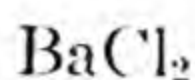
I-2175

Barium chloride will react with the potassium salt of phenyl dithio-diazolon sulfhydrate yielding a white precipitate.



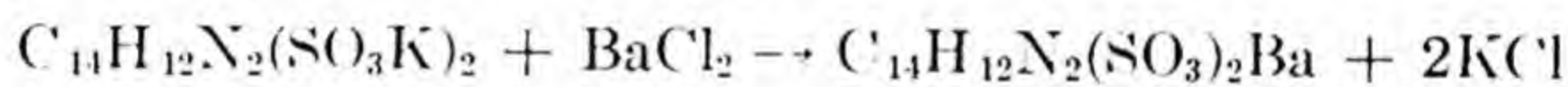
J. V. Dubsky and J. Trtilek, Z. anal. Chem., **96**, 414 (1934)

28



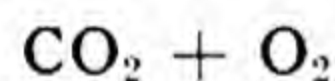
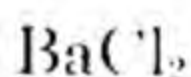
I-2176

A hot aqueous solution of dipotassium 2,2-dimethyl-4,4-azobenzol-sulfonate is treated with an aqueous solution of barium chloride as long as a precipitate forms. The precipitate is filtered off and dried. It is barium 2,2-dimethyl-4,4-azobenzolsulfonate and has no water of crystallization. A similar reaction occurs when this reagent is treated with calcium chloride or lead acetate. The calcium salt has three H₂O and the lead salt one H₂O.



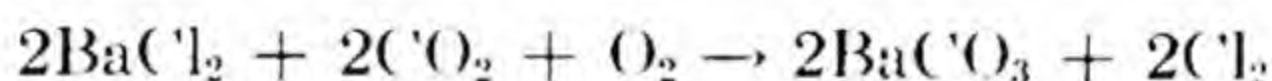
O. Kornatzki, Ann., **221**, 184 (1883)

20



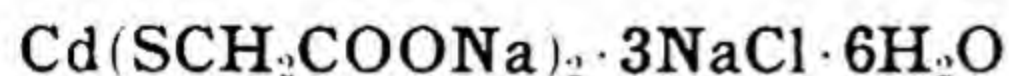
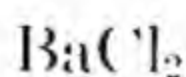
I-2177

Barium chloride is fused in the presence of carbon dioxide and oxygen.



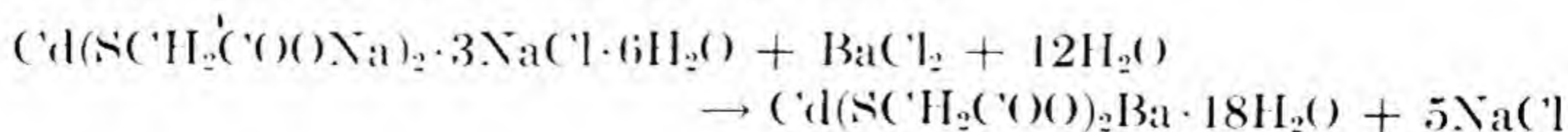
Haber, Z. anorg. Chem., **41**, 407 (1904)

25



I-2178

Barium cadmium thioglycolate is formed when cadmium thioglycolic sodium chloride reacts with barium chloride.



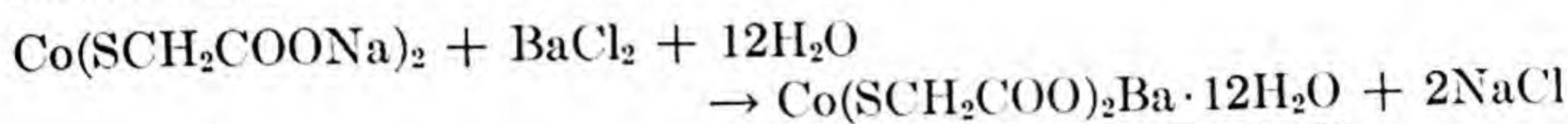
A. Rosenheim and I. Davidsohn, Z. anorg. Chem., **41**, 231 (1904)

28



I-2179

A brown colored precipitate of barium cobaltous thioglycolate is obtained when a solution of sodium cobaltothioglycolate reacts with barium chloride.



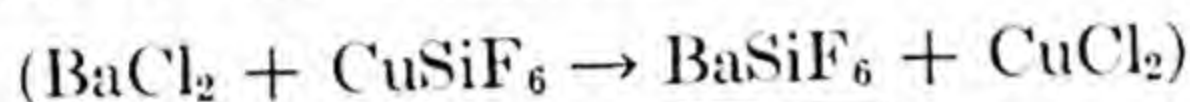
A. Rosenheim and I. Davidsohn, *Z. anorg. Chem.*, **41**, 231 (1904)

28



I-2180

A solution of copper fluosilicate gives a clear and sharp titration (by conductivity) of barium in solutions containing one volume of alcohol. The presence of other salts interferes with the end-point.



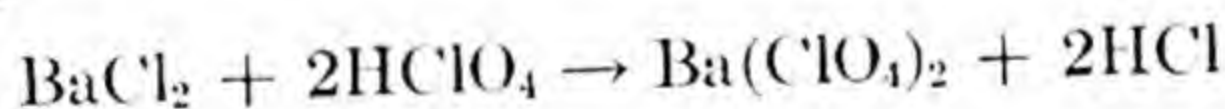
P. Dutoit and P. Mojoïu, *J. Chim. phys.*, **8**, 27 (1910)

69



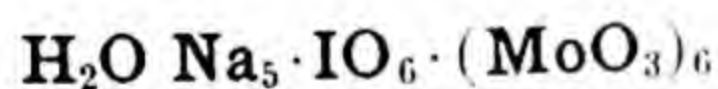
I-2181

Barium perchlorate is formed when barium chloride is evaporated with perchloric acid.



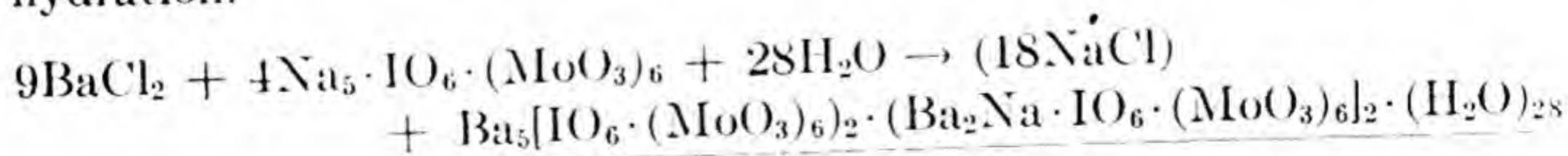
H. H. Willard and G. F. Smith, *J. Am. Chem. Soc.*, **45**, 287 (1923)

1



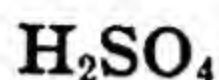
I-2182

When moderately concentrated solutions of barium chloride and of sodium hexa-molybdenum periodate are mixed there precipitate immediately small thin prisms of a complicated barium sodium hexa-molybdenum periodate containing twenty eight molecules of water of hydration.



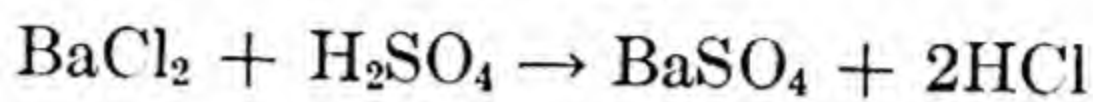
C. W. Blomstrand, *K. Sv. Vet. Akad. Handl. Bihang.*, **17**, III, No. 7, 37 (1892)

10



I-2183

Barium chloride reacts with sulfuric acid to form a white precipitate which is insoluble in hydrochloric acid.



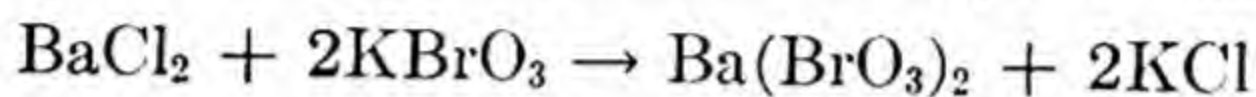
McBride and Weaver, J. Ind. Eng. Chem., **5**, 470 (1913)

22



I-2184

A solution of barium chloride is treated with potassium bromate.



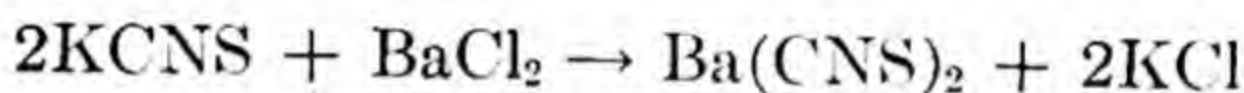
C. Sowig, Pharm. Mag., **33**, 6 (1831)

25



I-2185

A concentrated aqueous solution of barium chloride is added to a concentrated aqueous solution of potassium thiocyanate. The solution is concentrated in vacuo over sulfuric acid. Crystals of barium thiocyanate with one H₂O separate.



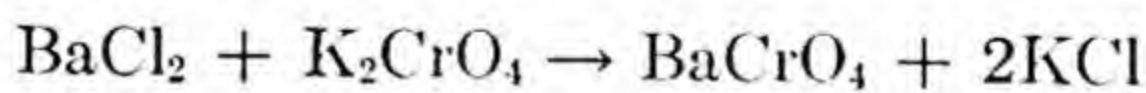
A. Fleischer, Ann., **179**, 215 (1875)

20



I-2186

In an acid solution barium chloride reacts with potassium dichromate producing a yellow precipitate.



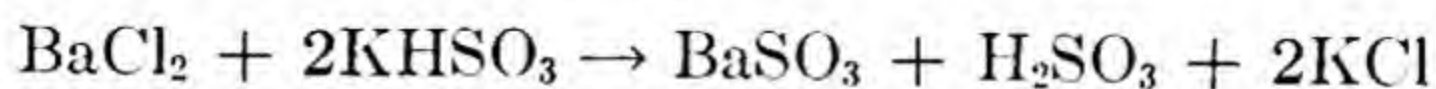
McBride and Weaver, J. Ind. Eng. Chem., **5**, 470 (1913)

22



I-2187

Barium sulfite and sulfurous acid are formed when a solution of potassium acid sulfite is treated with barium chloride.



A. Villiers, Bull. Soc. Chim., **47**, 545 (1887)

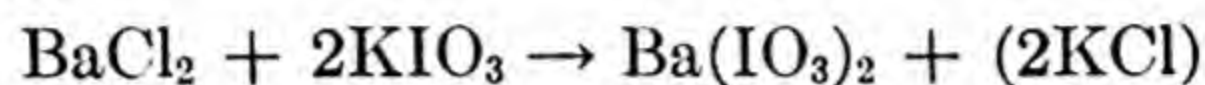
Ref.: M. L., J. Am. Chem. Soc., **9**, 118 (1887)

1



I-2188

A precipitate of barium iodate is formed when a hydrochloric acid solution of barium chloride is treated with a saturated solution of potassium iodate.



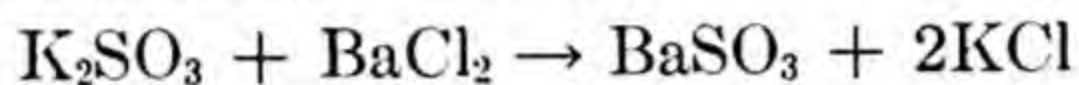
S. R. Benedict, *J. Am. Chem. Soc.*, **28**, 1597 (1906)

1



I-2189

Barium sulfite is precipitated when a neutral solution of potassium sulfite is treated with barium chloride.



A. Villiers, *Bull. Soc. Chim.*, **47**, 545 (1887)

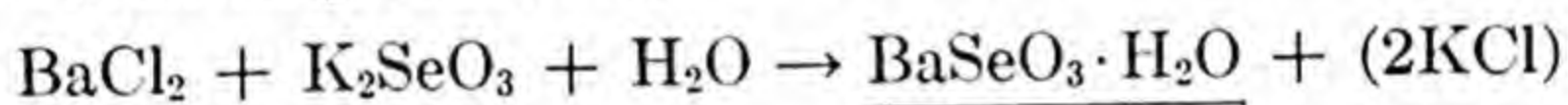
Ref., M. L., *J. Am. Chem. Soc.*, **9**, 118 (1887)

1



I-2190

When solutions of barium chloride and of potassium selenite are mixed, mono-hydrated barium selenite precipitates as white, microscopic, silky-lustered, truncated prisms, often in star-like clusters.



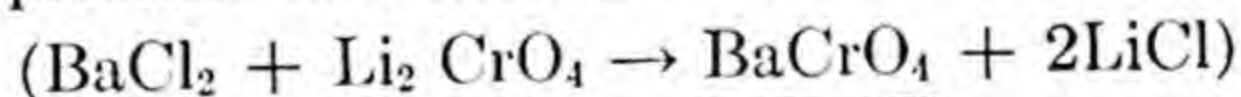
L. F. Nilson, *K. Sv. Vet. Akad. Handl. Öfvers.*, **31**, No. 1, 38 (1874)

10



I-2191

The electrometric titration of barium by lithium chromate gives excellent results in presence of a little alcohol.



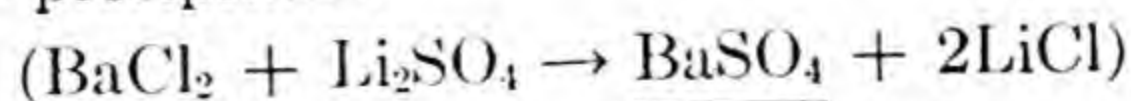
P. Dutoit and P. Mojoiu, *J. Chim. phys.*, **8**, 27 (1910)

69



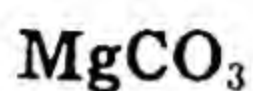
I-2192

The small solubility of barium sulfate in water makes possible the accurate titration by the conductivity method of solutions at least 0.01*N*. For more dilute solutions add a little alcohol to decrease the solubility of the precipitate.



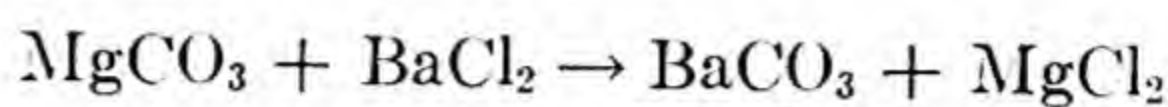
P. Dutoit and P. Mojoiu, *J. Chim. phys.*, **8**, 27 (1910)

69



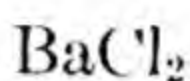
I-2193

If a solution of barium chloride is stirred in a closed vessel with magnesium carbonate, simultaneously adding carbonic acid, barium carbonate is precipitated while the magnesium chloride remains in solution.



E. T. Hughes, Brit. Pat. No. 938 Ber., **8**, (1), 169 (1875)

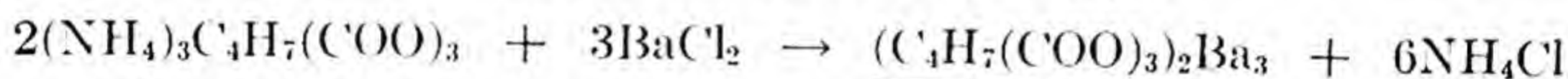
26



I-2194

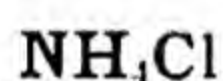
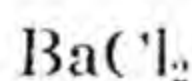
Ammonium butenyltricarboxylate is dissolved in water and treated with an aqueous solution of barium chloride. Barium butenyltricarboxylate is precipitated.

A similar reaction occurs when this reagent is treated with silver nitrate. The silver salt has one and one half H₂O.

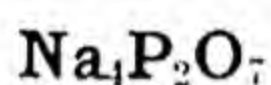


G. Polko, Ann., **242**, 117 (1887)

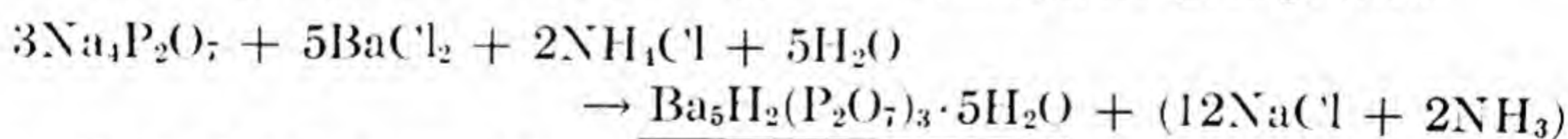
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I-2195

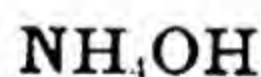
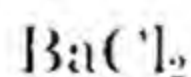


When a very dilute barium chloride solution mixed with ammonium chloride solution is added to a normal sodium pyrophosphate solution 5:2:3:5 hydrated barium hydrogen pyrophosphate precipitates.

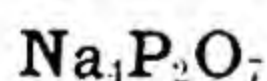


C. N. Pahl, Ark. Kem., Min., Geol., **2**, Part 6, 3 (1905)

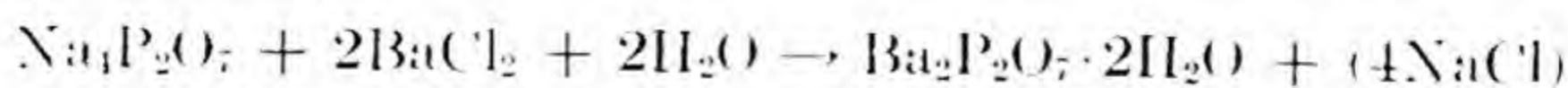
10



I-2196

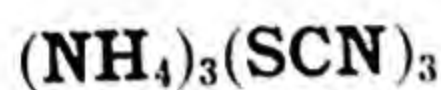


When a solution of normal sodium pyrophosphate is added to a solution of barium chloride rendered alkaline with ammonium hydroxide an amorphous precipitate of di-hydrated normal barium pyrophosphate forms immediately.



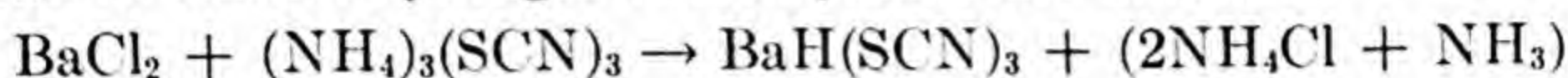
C. N. Pahl, Ark. Kem., Min., Geol., **2**, Part 6, 1 (1905)

10



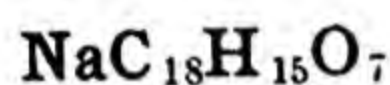
I-2197

When barium chloride is added to ammonium trithiocyanate and the solution allowed to crystallize, small transparent or larger yellow crystals of barium hydrogen trithiocyanate are obtained.



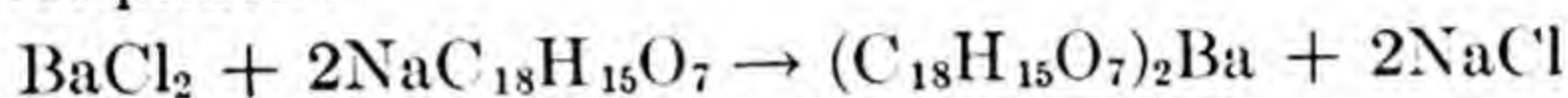
P. Claesson, K. Sv. Vet. Akad. Handl. Bihang., **9**, No. 17, 9 (1884)

10



I-2198

When solutions of barium chloride and sodium usnate are mixed barium usnate precipitates. Chlorides of calcium, silver, copper and lead give similar precipitates.



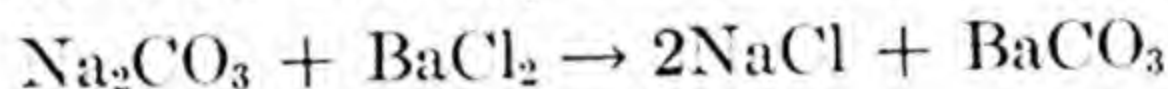
O. Widman, K. Sv. Vet. Akad. Handl. Bihang., **25**, II, No. 6, 18 (1900)

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I-2199

In using barium chloride to form non-foaming soap in toluene water determination test on soaps, care must be taken to have enough barium chloride present to react with any sodium carbonate filler.



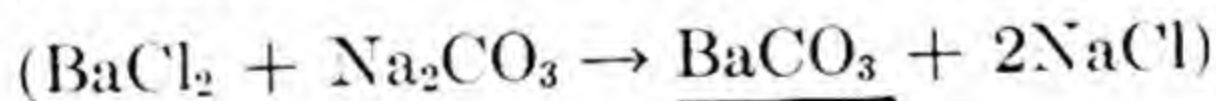
Ralf B. Trusler, Oil and Soap, **16**, 12, 239 (1939)

111



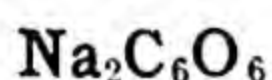
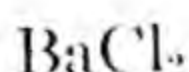
I-2200

Barium carbonate is precipitated faster than calcium or strontium carbonates. However this reaction is less accurate than the chromate or the sulfate for titration by the conductivity method.



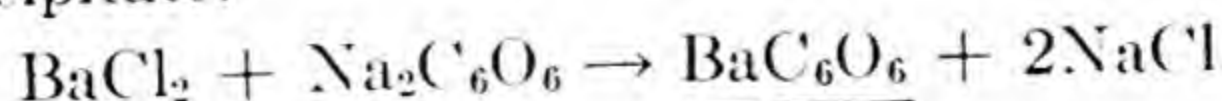
P. Dutoit and P. Mojoiu, J. Chim. phys., **8**, 27 (1910)

69



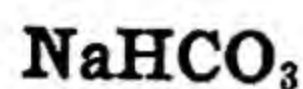
I-2201

Barium chloride reacts with sodium rhodizonate, yielding a characteristic red precipitate.



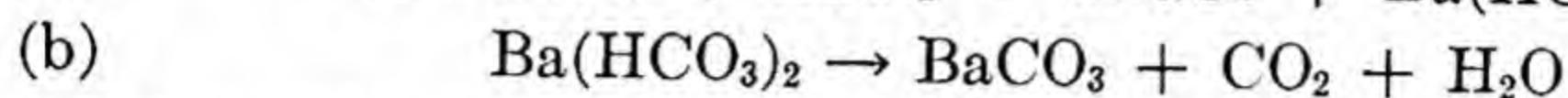
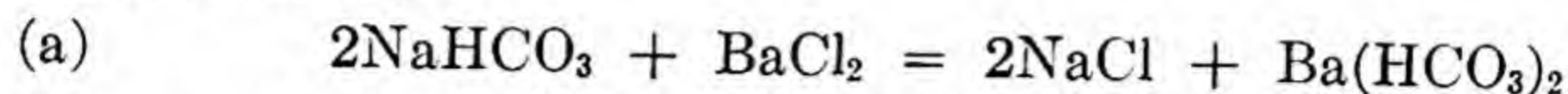
F. Feigl and H. Ordelt, Mikrochem., **2**, 187 (1924)

28



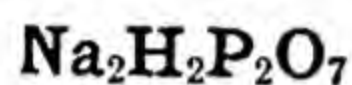
I-2202

In using barium chloride to form non-foaming soap in toluene water determination test on soap, care must be taken in case there is any bicarbonate present as filler for decomposition of the bicarbonate may occur as shown.



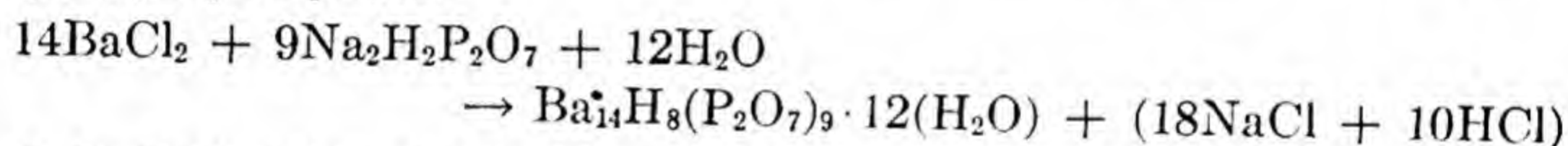
Ralf B. Trusler, *Oil and Soap*, **16**, 12, 239 (1939)

111



I-2203

When barium chloride solution is added to disodium-dihydrogen-pyrophosphate solution there appears after some hours wart-like clusters of small crystals of dodeca-hydrated 14:8:9 barium-hydrogen-pyrophosphate.



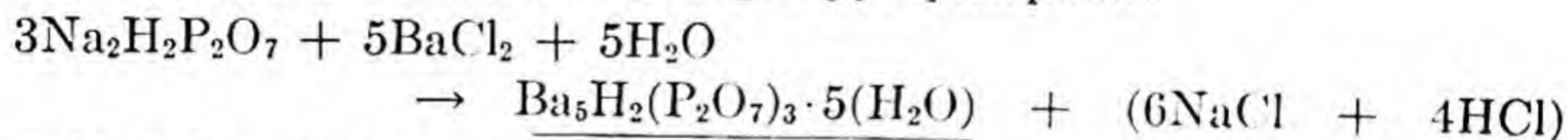
C. N. Pahl, *Arkiv. Kemi., Mineral., Geologi.*, **2**, Part 6, 3 (1905)

10



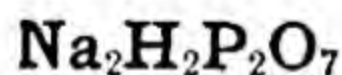
I-2204

The addition of a disodium-dihydrogen-pyrophosphate solution to a barium chloride solution precipitates immediately granular crystalline 5:2:3:5 hydrated barium hydrogen pyrophosphate.



C. N. Pahl, *Arkiv. Kemi., Mineral., Geologi.*, **2**, Part 6, 3 (1905)

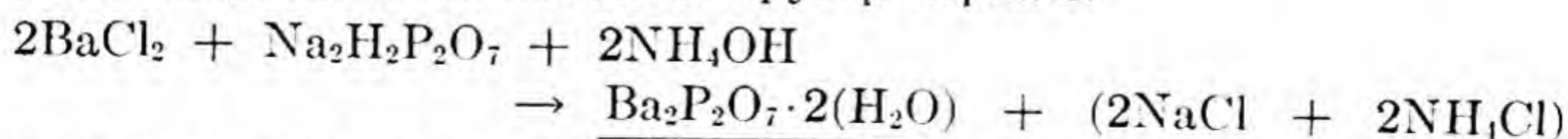
10



I-2205



Solutions of disodium-dihydrogen-pyrophosphate, barium chloride and ammonium hydroxide, when mixed, precipitate immediately amorphous dihydrated normal barium pyrophosphate.



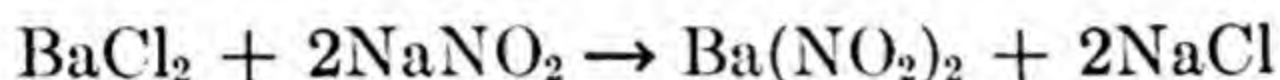
C. N. Pahl, *Arkiv. Kemi., Mineral., Geologi.*, **2**, Part 6, 1 (1905)

10



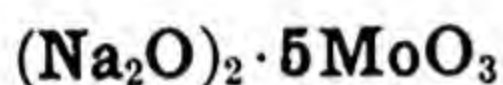
I-2206

A concentrated solution of barium chloride reacts near 100° with sodium nitrite.



J. Matuschek, Ber., **40**, 990 (1907)

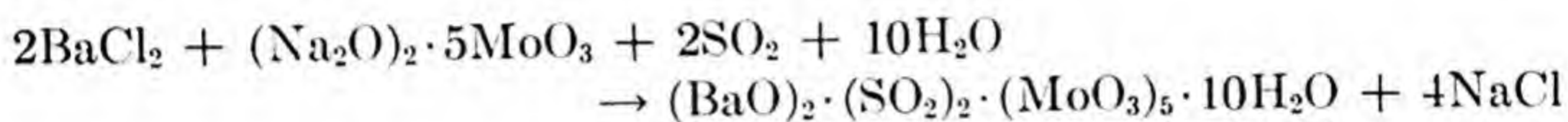
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I-2207

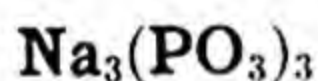


A saturated solution of barium chloride will react with a solution of sodium paramolybdate which has previously been saturated with sulfur dioxide, yielding prismatic crystals.



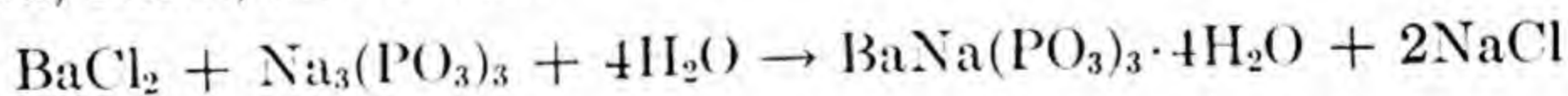
A. Rosenheim, Z. anorg. Chem., **15**, 180 (1897)

28



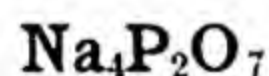
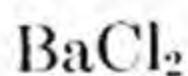
I-2208

Solutions of barium chloride and sodium trimetaphosphate are mixed and evaporated. Small, oblique prisms of tetrahydrated barium sodium trimetaphosphate form. Similar method gives these double salts, usually crystalline and hydrated,—BaNH₄, BaK, SrNa, CaNa, MgNa, NiNa, and CoNa.



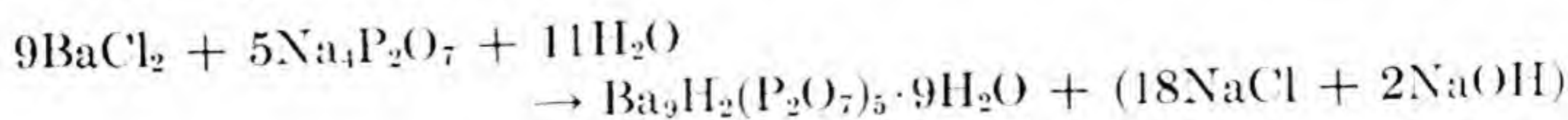
C. G. Lindbom, Acta Univ. Lund., **10**, Part 2, No. 7, 21-27 (1873)

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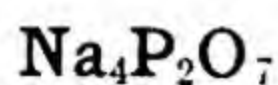
I-2209

When barium chloride and normal sodium pyrophosphate solutions are mixed with either reagent in excess the 9:2:5:9 hydrated barium hydrogen pyrophosphate precipitates as an amorphous powder.



C. N. Pahl, Ark., Kem., Min., Geol., **2**, Part 6, 2 (1905)

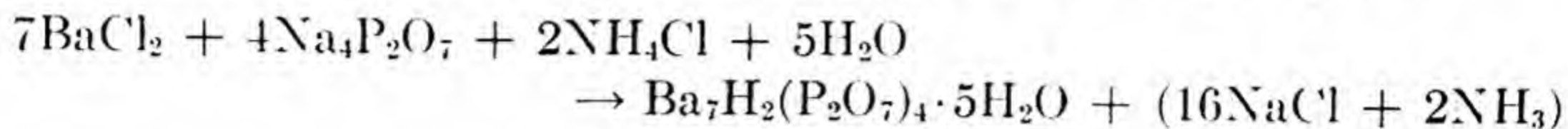
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I-2210

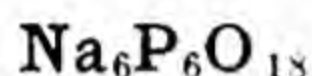


When ammonium chloride solution is added to normal sodium pyrophosphate solution and then barium chloride solution is added, the 7:2:4:5 hydrated barium hydrogen pyrophosphate precipitates.



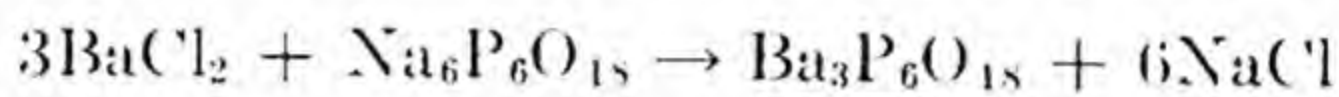
C. N. Pahl, Ark., Kem., Min., Geol., **2**, Part 6, 2 (1905)

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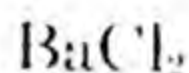
I-2211

A diluted solution of barium chloride will react with a diluted solution of sodium hexametaphosphate yielding a precipitate of white color.



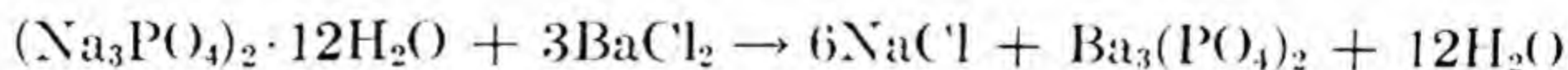
H. Lüdert, Z. anorg. Chem., **5**, 15 (1894)

28



I-2212

In using barium chloride to form non-foaming soap in toluene water determination test on soaps, care must be taken to have enough barium chloride present to take care of any phosphate filler present.



Ralf B. Trusler, Oil and Soap, **16**, 12, 239, (1939)

111



I-2213

A solution of barium chloride added to a solution of sodium sulfite precipitates barium sulfite.



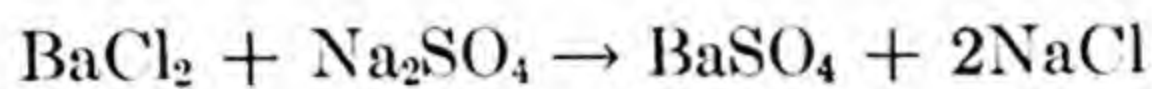
K. Seubert and M. Elten, Z. anorg. Chem., **4**, 44 (1893)

28



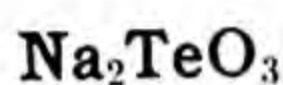
I-2214

In testing for a change of weight during chemical reactions, separate solutions in a sealed tube were mixed. These were aqueous solutions of barium chloride and sodium sulfate; they formed barium sulfate and sodium chloride.



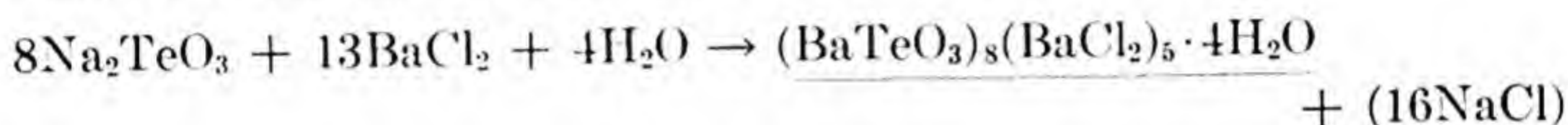
J. J. Manley, Trans. Roy. Soc. (London) **212A**, 258 (1913)

105



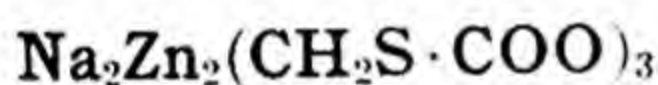
I-2215

Barium tellurite containing some barium chloride precipitates when a solution of barium chloride reacts with sodium tellurite.



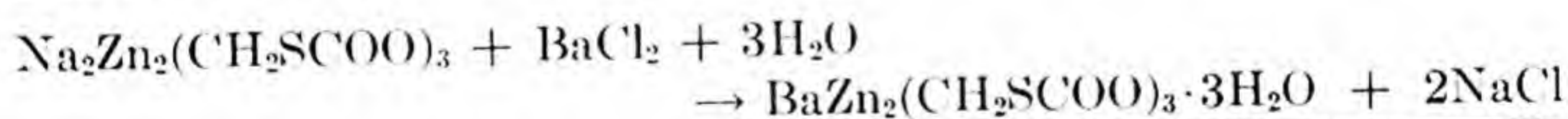
V. Lenher and E. Wolesensky, J. Am. Chem. Soc., **35**, 725 (1913)

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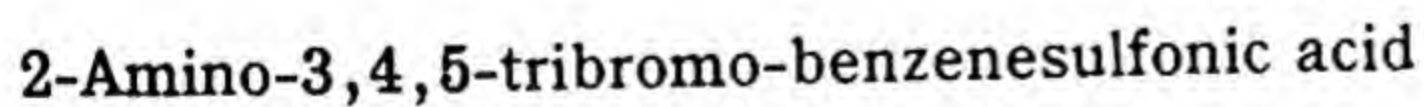
I-2216

By adding barium chloride to a solution of sodium zinc-thioglycolate a crystalline precipitate, the barium salt of the complex zinc-thioglycolic acid is obtained.



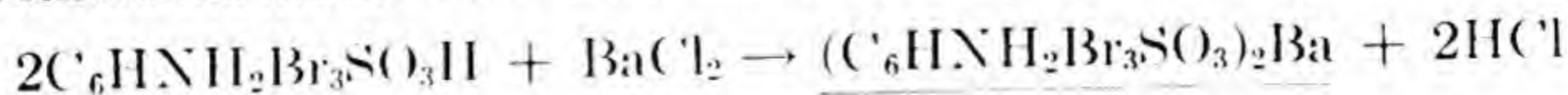
A. Rosenheim and I. Davidsohn, Z. anorg. Chem., **41**, 231 (1904)

28



I-2217

An aqueous solution of barium chloride is added to 2-amino-3,4,5-tribromobenzenesulfonic acid as long as a precipitate forms. The precipitated salt is recrystallized from water and barium-2-amino-3,4,5-tribromobenzenesulfonate with one and one half H₂O separates.

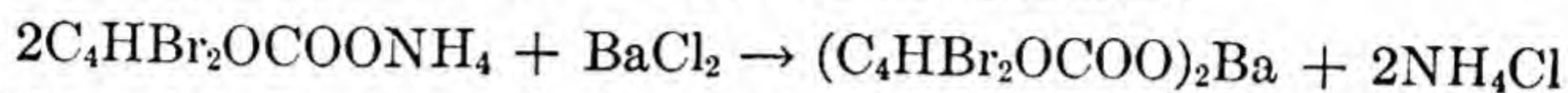


W. Lenz, Ann., **181**, 44 (1876)

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**Ammonium 3,4-dibromo-alpha-furoate****I-2218**

A dilute aqueous solution of ammonium 3,4-dibromo-alpha-furoate is treated with barium chloride, the residue filtered, washed and dried. It may be recrystallized from hot water and crystals of barium 3,4-dibromo-alpha-furoate with three H₂O are obtained.

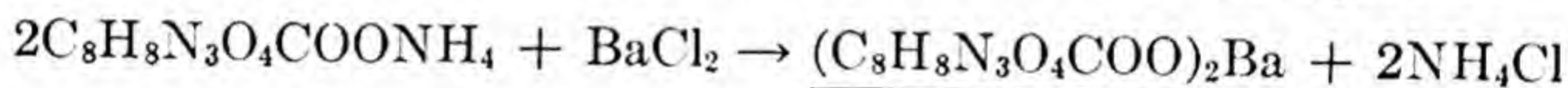


H. Hill and C. Sanger, *Ann.*, **232**, 83 (1886)

20

**Ammonium 3,5-dinitro-4-aminophenylpropionate****I-2219**

An aqueous solution of ammonium 3,5-dinitro-4-amino-phenylpropionate is treated with a solution of barium chloride. Barium 3,5-dinitro-4-aminophenylpropionate with one and one half H₂O precipitates.

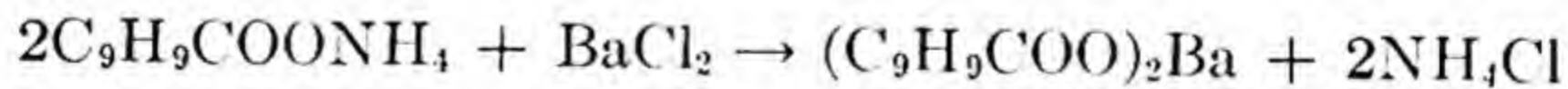


C. Stohr, *Ann.*, **225**, 88 (1884)

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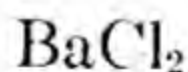
**Ammonium isopropenyl benzoate****I-2220**

An aqueous solution of ammonium isopropenylbenzoate is treated with an aqueous solution of barium chloride, filtered and the residue dried. Barium isopropenylbenzoate with one H₂O is formed. A similar reaction occurs when this reagent is treated with calcium chloride, cupric sulfate or silver nitrate. The calcium salt has one and one-half H₂O and the others are water-free.

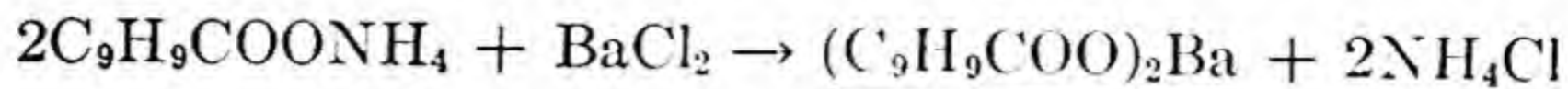


R. Meyer, *Ann.*, **219**, 283-4 (1883)

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**Ammonium propenyl benzoate****I-2221**

An aqueous solution of ammonium propenyl benzoate is warmed and treated with an aqueous solution of barium chloride. The precipitate is barium propenyl benzoate and has one H₂O. A similar reaction occurs when this reagent is treated with cupric sulfate or silver nitrate.



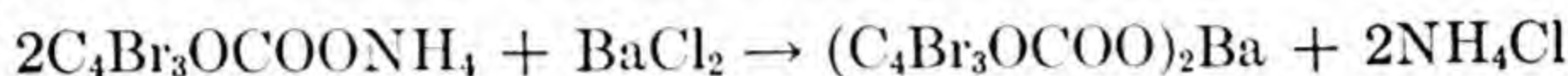
R. Meyer, *Ann.*, **219**, 281 (1883)

20

**Ammonium 3,4,5-tribromo-alpha-furoate****I-2222**

A dilute aqueous solution of ammonium 3,4,5-tribromo-alpha-furoate is treated with an aqueous solution of barium chloride, the precipitate filtered off and washed. The barium 3,4,5-tribromo-alpha-furoate may be recrystallized from hot water and contains three H₂O.

A similar reaction occurs when this reagent is treated with calcium chloride. The calcium salt has four H₂O.



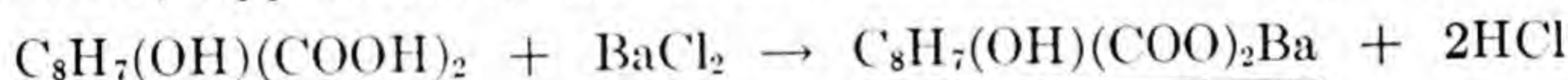
H. Hill and C. Sanger, *Ann.*, **232**, 92 (1886)

20

**Benzyl tartronic acid****I-2223**

An aqueous solution of benzyl tartronic acid is treated with an aqueous solution of barium chloride and the precipitate dried. Barium benzyl tartronate is formed.

A similar reaction occurs when this reagent is treated with calcium chloride, copper sulfate, zinc acetate, silver nitrate or lead acetate.

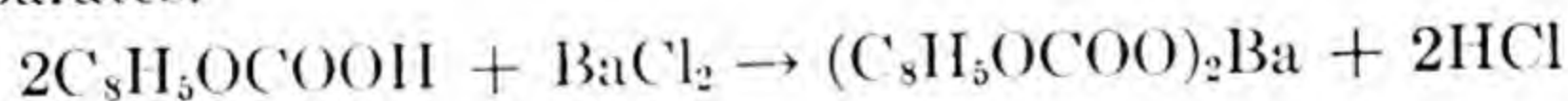


M. Conrad, *Ann.*, **209**, 246 (1881)

20

**Coumarilic acid****I-2224**

An aqueous solution of coumarilic acid is neutralized with ammonium hydroxide and then treated with an aqueous solution of barium chloride. The precipitate is filtered off and dried. Barium coumarilate with three H₂O separates.

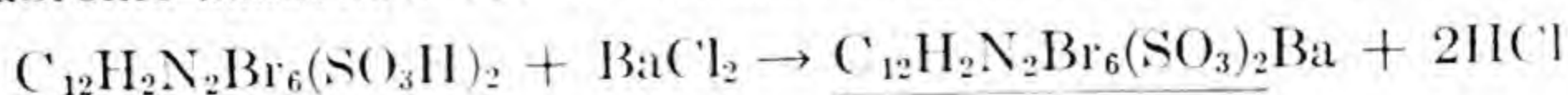


R. Fittig and G. Ebert, *Ann.*, **216**, 164 (1883)

20

**2,4,6,2,4,6-Hexabromo-azobenzol-3,3-disulfonate****I-2225**

2,4,6,2,4,6-Hexabromo-azobenzol-3,3-disulfonic acid is dissolved in hot water and a hot aqueous solution of barium chloride added, the solution filtered while hot and allowed to cool. Barium-2,4,6,2,4,6-hexabromo-azobenzol-3,3-disulfonate with two H₂O separate.



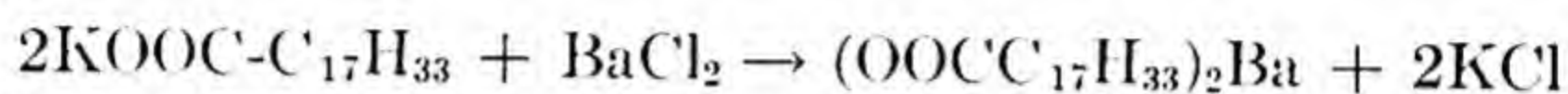
P. Rodatz, *Ann.*, **215**, 226 (1882)

20

**Potassium Oleate****I-2226**

In a method for determining amount of water in soaps, the use of barium chloride is advocated, as the foaming tendency is eliminated. The treatment with barium chloride is made in the toluene distillation for water.

Water not shown, as only its presence is needed to cause reaction to take place: anhydrous soaps may need a trace of water to facilitate reaction.

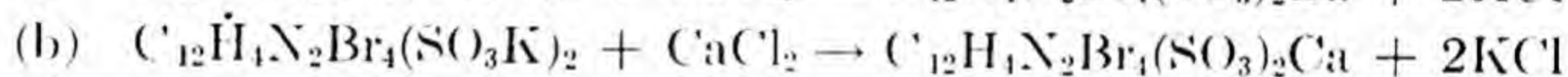
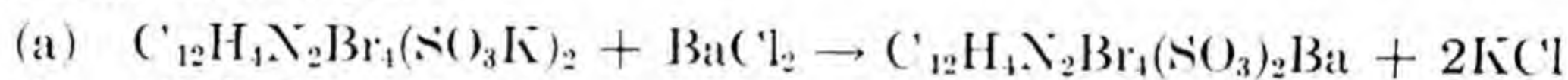


Ralf B. Trusler, *Oil and Soap*, **16**, 12, 239 (1939)

111

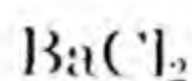
**Potassium 2,2,4,4-tetrabromo-azobenzol-5,5-disulfonate****I-2227**

Potassium-2,2,4,4-tetrabromo-azobenzol-5,5-disulfonate in aqueous solution is treated with an aqueous solution of barium chloride and the residue washed with water. Barium 2,2,4,4-tetrabromo-azobenzol-5,5-disulfonate with one H_2O is formed. A similar reaction occurs when this reagent is treated with calcium chloride. The calcium salt contains four H_2O .

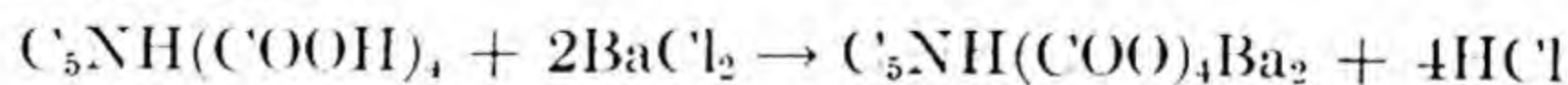


P. Rodatz, *Ann.*, **215**, 219 (1882)

20

**Pyridine tetracarboxylic acid****I-2228**

An aqueous solution of pyridine tetracarboxylic acid is treated with an aqueous solution of barium chloride, the solution filtered and the residue dried. It is barium pyridine tetracarboxylate and has two and one half H_2O .

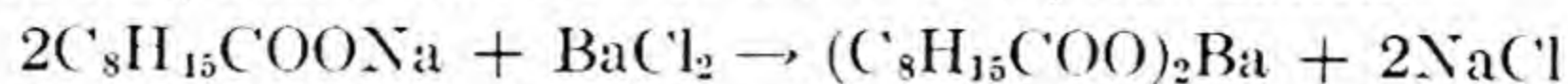


R. Michael, *Ann.*, **225**, 145 (1884)

20

**Sodium nonylenate****I-2229**

Sodium nonylenate is dissolved in water and an aqueous solution of barium chloride added. The residue is filtered off and dried. It is barium nonylenate and has no water of crystallization.



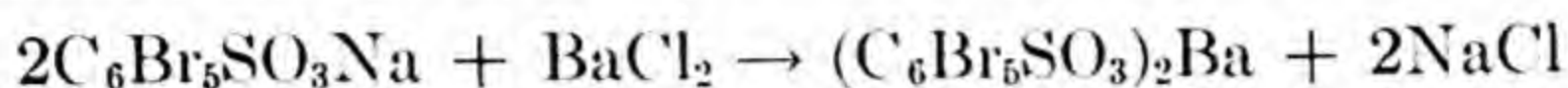
R. Fittig and A. Schneegans, *Ann.*, **227**, 82 (1885)

20

**Sodium-pentabromobenzenesulfonate**

I-2230

A hot aqueous solution of sodium pentabromobenzenesulfonate is treated with an aqueous solution of silver nitrate as long as a precipitate forms, the solution filtered and cooled. Crystals of barium pentabromobenzenesulfonate with one H₂O separate.



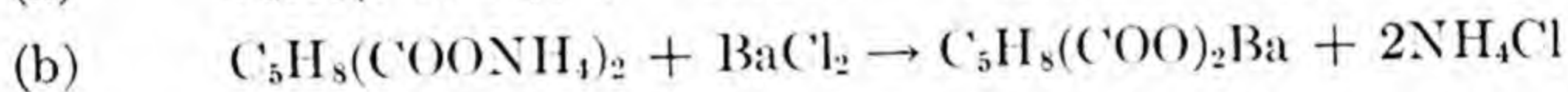
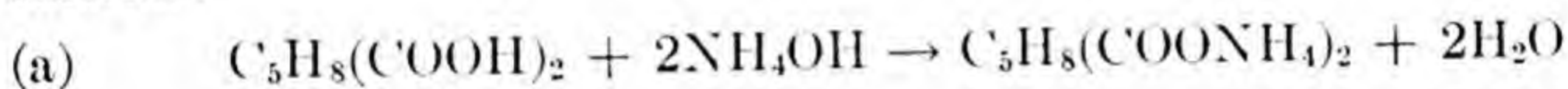
Heinzelmann and Spiegelberg, *Ann.*, **197**, 310 (1879)

20

**Teraconic acid**

I-2231

A dilute aqueous solution of teraconic acid is neutralized with ammonium hydroxide and an aqueous solution of barium chloride added. The solution is warmed and crystals of barium teraconate separate. A similar reaction occurs when this reagent is treated with calcium chloride.



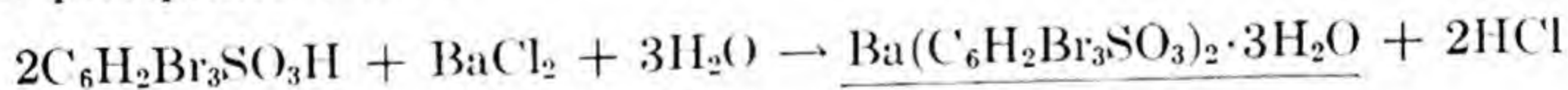
R. Fittig and C. Geisler, *Ann.*, **208**, 51 (1881)

20

**3,4,5-Tribromo benzenesulfonic acid**

I-2232

A cold, dilute aqueous solution of 3,4,5-tribromobenzenesulfonic acid is treated with an aqueous solution of barium chloride as long as a precipitate forms.



W. Lenz, *Ann.*, **181**, 30 (1876)

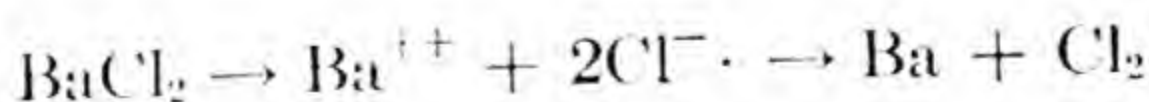
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I-2233

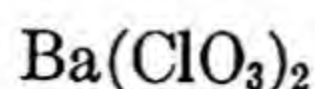
A solution of barium chloride is electrolyzed at 100° using mercury as the cathode.



Bunsen, *Pogg. Ann.*, **91**, 619

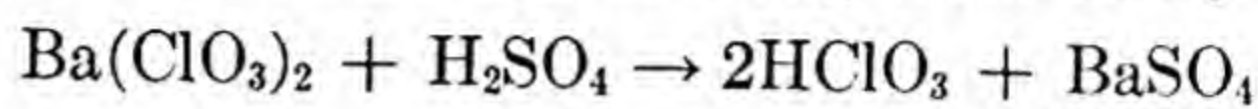
Ref., Matthiessen, *J. Prakt. Chem.*, **67**, 494

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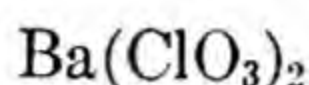
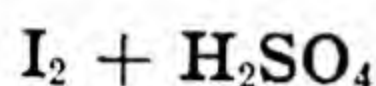
I-2234

A solution of chloric acid is prepared by addition of sulfuric acid to barium chlorate, the barium sulfate being removed by filtration.



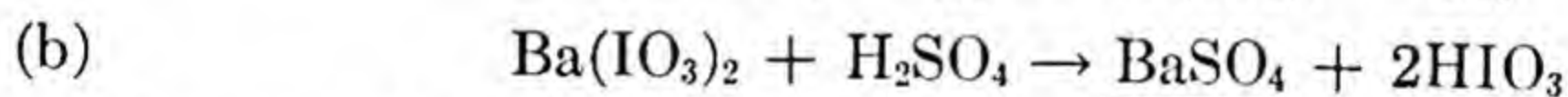
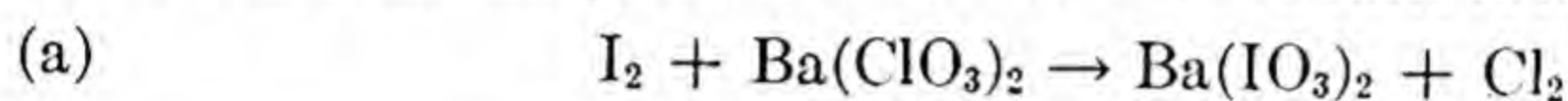
R. R. Enfield: J. Chem. Soc., (London), **97**, 2446 (1910)

57



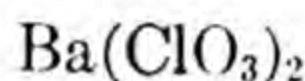
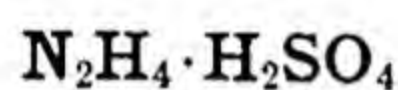
I-2235

Iodic acid is formed when equivalent amounts of barium chlorate and iodine react and the product is treated with sulfuric acid.



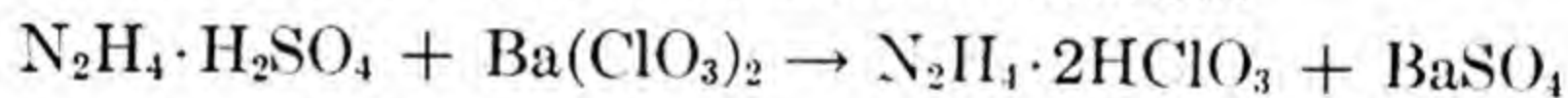
Lamb, Bray and Geldard, J. Am. Chem. Soc., **42**, 1636 (1920)

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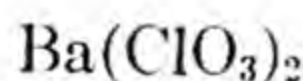
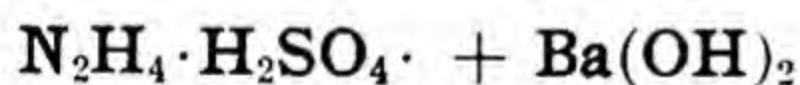
I-2236

Hydrazine chlorate is formed when hydrazine sulfate reacts with the theoretical amount of barium chlorate in solution.



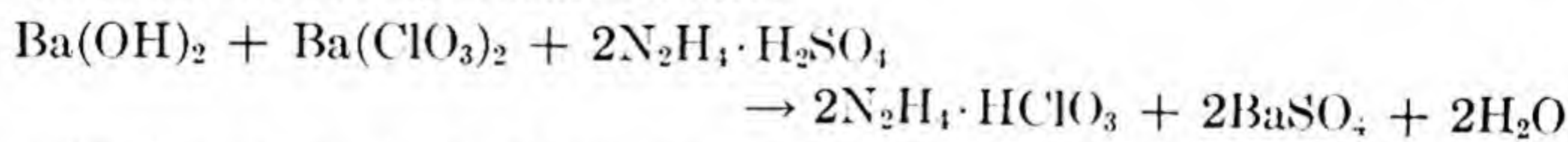
J. W. Turrentine, J. Am. Chem. Soc., **37**, 1123 (1915)

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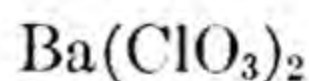
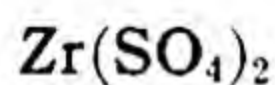
I-2237

Hydrazine monochlorate is produced when barium chlorate and hydroxide are added to hydrazine sulfate.



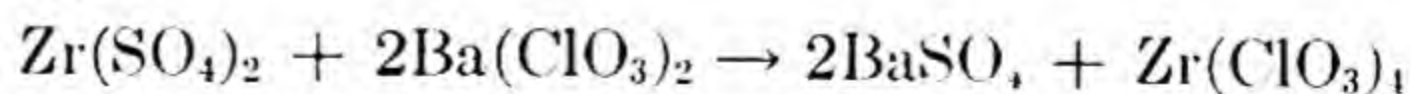
J. W. Turrentine, J. Am. Chem. Soc., **37**, 1107 (1915)

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I-2238

Zirconium chlorate is formed when zirconium sulfate reacts with barium chlorate.



Weibull, Act. Univ. Lund., **53**, 11, 18 (1881)

Ref., Venable and Smithey, J. Am. Chem. Soc., **41**, 1725 (1919)

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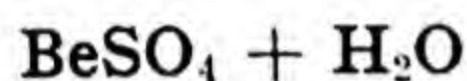
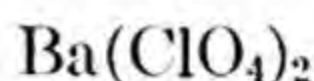
I-2239

Barium chlorate is heated to 310°.



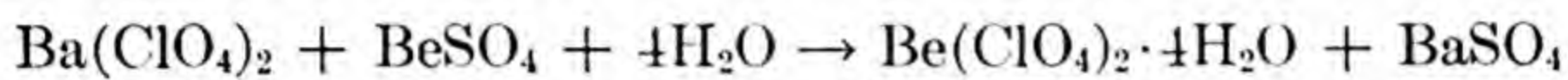
Potilitzin, Ber., **3**, 769 (1870)

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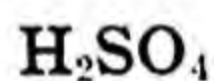
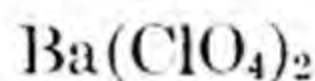
I-2240

Solutions of beryllium sulfate and barium perchlorate are added together and the filtrate evaporated.



Marignac, Ann. Chim. (4), **30**, 45 (1873)

25



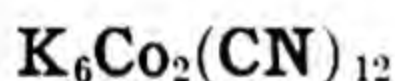
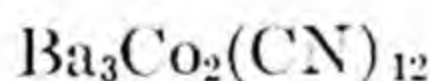
I-2241

Perchloric acid is formed when sulfuric acid reacts with barium perchlorate.



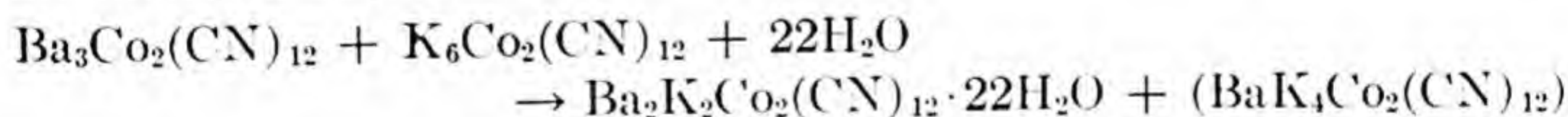
F. C. Mathers, J. Am. Chem. Soc., **32**, 67 (1910)

1



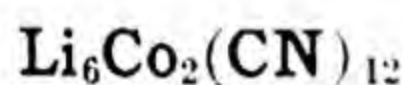
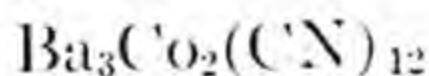
I-2242

When solutions of barium cobalticyanide and potassium cobalticyanide are mixed, a double salt is formed.



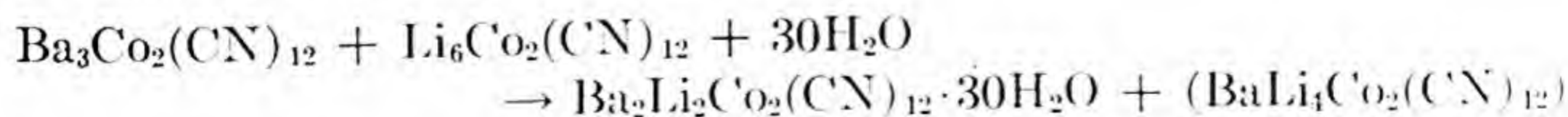
P. Weselsky, Ber., **2**, 595 (1869)

11



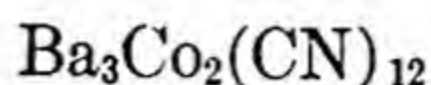
I-2243

When solutions of barium cobalticyanide and lithium cobalticyanide are mixed, a double salt is formed.



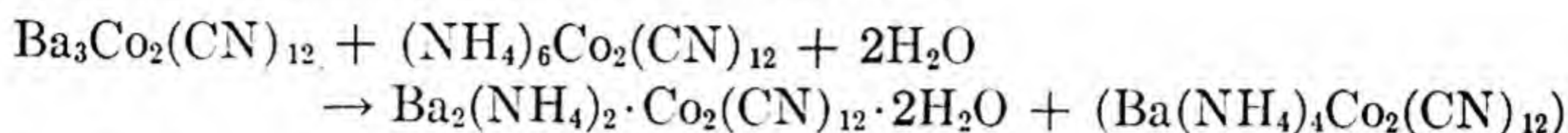
P. Weselsky, Ber., **2**, 595 (1869)

11



I-2244

When solutions of barium cobalticyanide and ammonium cobalticyanide are mixed, a double salt is formed.



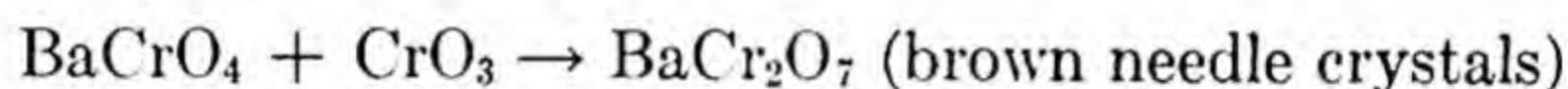
P. Weselsky, Ber. **2**, 595 (1869)

11



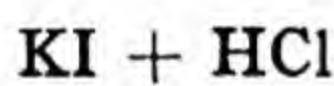
I-2245

Freshly precipitated barium chromate and chromic anhydride are ground together.



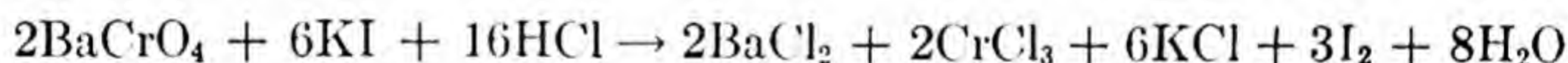
Autenrieth, Ber., **35**, 2057 (1902)

25



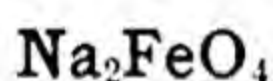
I-2246

A solution of barium chromate is treated with hydrochloric acid and potassium iodide.



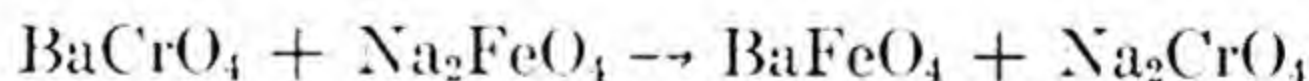
R. E. Bradley, Chem. Engr., **13**, 26

25



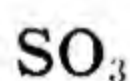
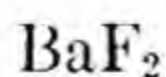
I-2247

Barium ferrate is formed when sodium ferrate is digested with barium chromate.



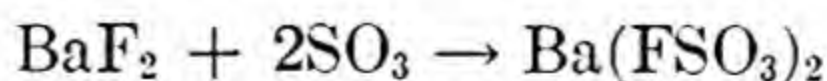
C. A. O. Rosell, J. Am. Chem. Soc., **17**, 766 (1895)

1



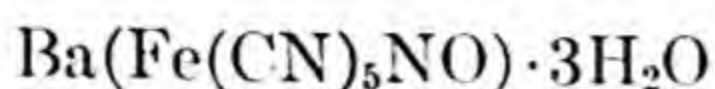
I-2248

Perfectly dry barium fluoride reacts with sulfur trioxide.

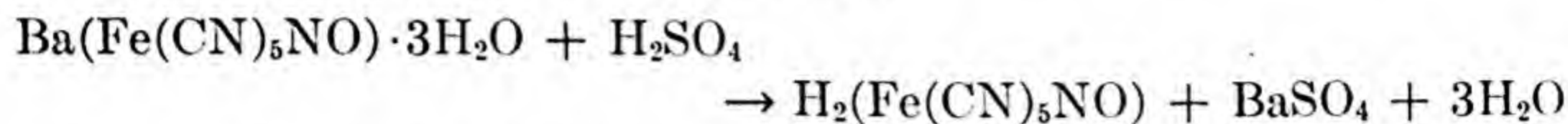


W. Traube, J. Hoerenz and F. Wunderlick, Ber., **52**, 1272 (1919)

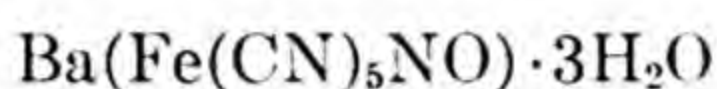
25

**H₂SO₄****I-2249**

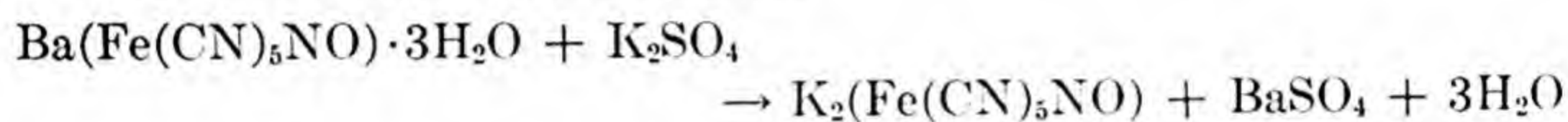
Free nitro-prussic acid may be obtained by mixing equivalent amounts of barium nitroprusside and sulfuric acid.



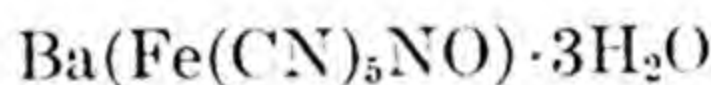
George J. Burrows and Eustace E. Turner, J. Chem. Soc., **115**, 1434 (1919) 48

**K₂SO₄****I-2250**

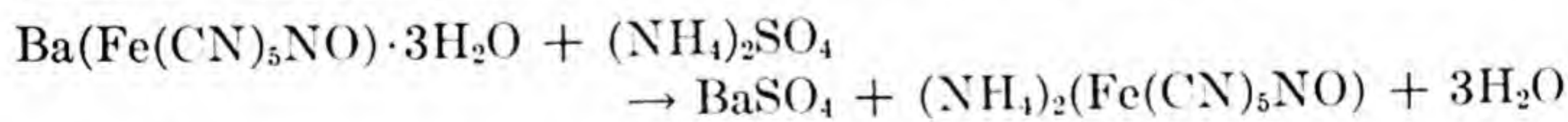
If barium nitro-prusside is treated with potassium sulfate, and the resulting barium sulfate is removed by filtration, and if the filtrate is evaporated at low temperature under diminished pressure, a residue of potassium nitro-prusside is obtained which, upon crystallization in 95% alcohol, gives pink crystals.



George J. Burrows and Eustace E. Turner, J. Chem. Soc., **115**, 1432 (1919) 48

**(NH₄)₂SO₄****I-2251**

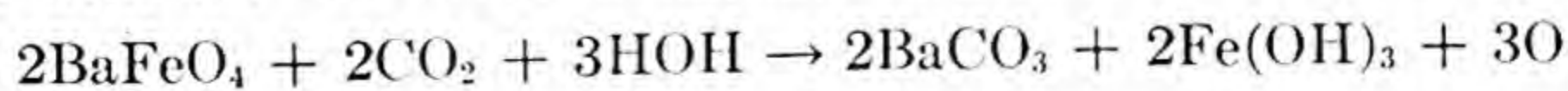
Ammonium nitro-prusside can be obtained by decomposing the barium salt with an equivalent weight of ammonium sulfate, filtering, evaporating under diminished pressure and crystallizing from aqueous alcohol. Reddish plates, readily soluble in water, are obtained.



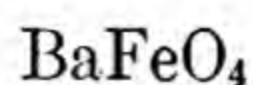
George J. Burrows and Eustace E. Turner, J. Chem. Soc., **115**, 1433 (1919) 48

**CO₂****I-2252**

Barium ferrate which has not been allowed to dry, suspended in water through which carbon dioxide is passed, is completely decomposed with the formation of barium carbonate and ferric hydroxide.

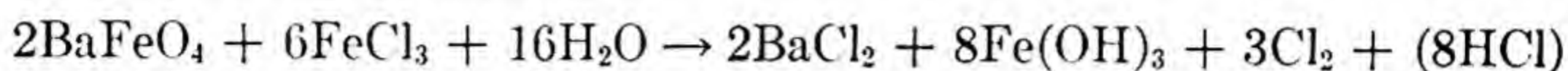


C. A. O. Rosell, J. Am. Chem. Soc., **17**, 765 (1895) 1

FeCl₃

I-2253

Ferric hydroxide is precipitated when solutions of ferric chloride and barium ferrate are mixed.



C. A. O. Rosell, J. Am. Chem. Soc., **17**, 765 (1895)

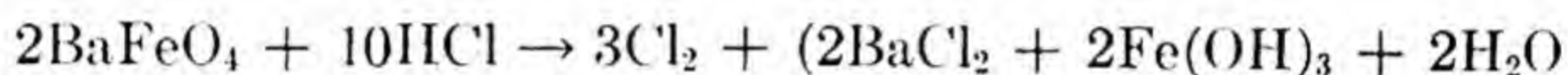
1



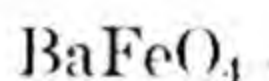
HCl

I-2254

Barium ferrate which has been completely dried in a desiccator is easily and completely decomposed by hydrochloric acid, chlorine being set free.



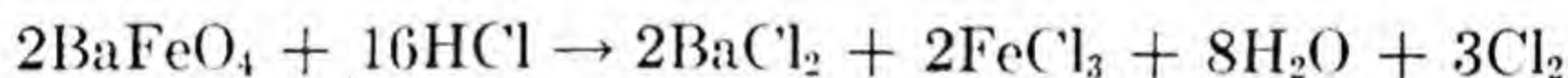
C. A. O. Rosell, J. Am. Chem. Soc., **17**, 766 (1895)



HCl

I-2255

Very dilute hydrochloric acid acts on barium ferrate to give barium chloride, ferric chloride, water and chlorine.



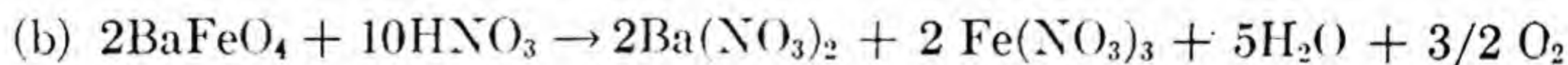
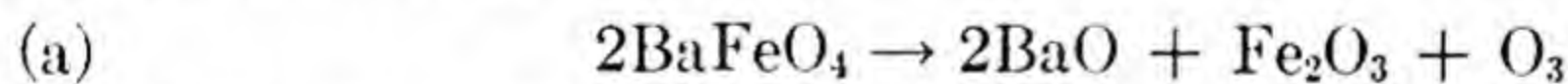
E. Baschieri, Gazz. Chim. Ital. **36**², 284 (1906)

21

HNO₃

I-2256

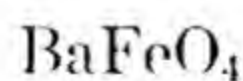
Barium ferrate is decomposed by nitric acid to oxygen, barium oxide (nitrate)? and ferric oxide (nitrate)?.



J. de Mollins,

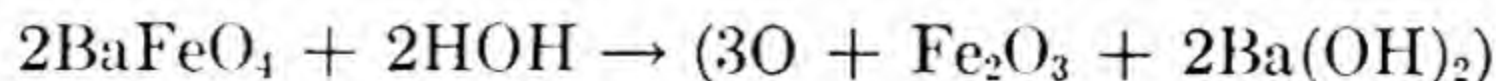
Ref.: O. Meister, Ber., **4**, 627 (1871)

11

H₂O

I-2257

Barium ferrate liberates oxygen when subjected to steam.



Maréchal and Tessie du Motay, Brit. Pat. No. 85 Jan. 10, 1886

Ref., J. Am. Chem. Soc., **17**, 767 (1895)

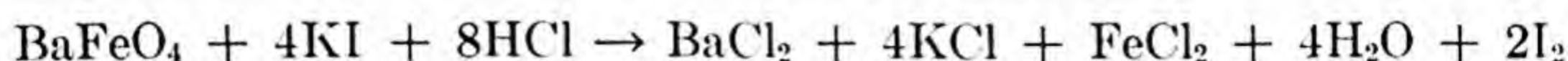
1



KI, HCl

I-2258

Barium ferrate reacts with potassium iodide in the presence of hydrochloric acid quantitatively to liberate free iodine.



J. de Mollins,

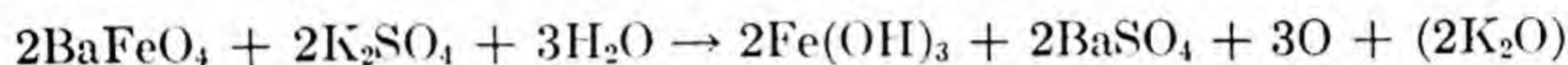
Ref.: O. Meister, Ber., **4**, 626 (1871)

11

K₂SO₄

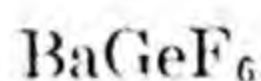
I-2259

An alkaline sulfate decomposes barium ferrate which has not been dried, forming barium sulfate, ferric hydroxide and oxygen.



C. A. O. Rosell, J. Am. Chem. Soc., **17**, 766 (1895)

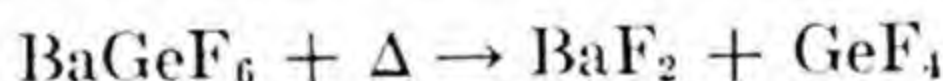
1



Δ

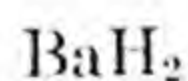
I-2260

Barium fluogermanate is heated to 700°.



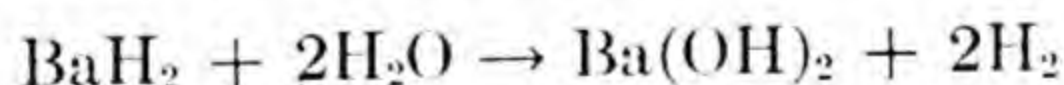
L. M. Dennis, Z. Anorg. Chem., **174**, 144 (1928)

25

H₂O

I-2261

Barium hydride is decomposed by water.



Gunz, Compt. rend., **132**, 963 (1901)

25

Ref., Guntz, Ann. chim. phys., [VIII], **4**, 20 (1905)

100

N₂

I-2262

Barium hydride is heated to redness in an atmosphere of nitrogen.

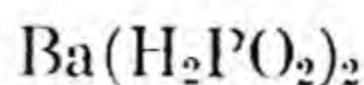


Gunz, Compt. rend., **132**, 963 (1901)

25

Ref., Guntz, Ann. chim. phys., [VIII], **4**, 20 (1905)

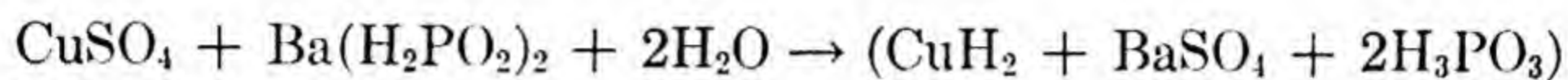
100



CuSO₄

I-2263

Cupric hydride was obtained by precipitating a solution of copper sulfate with barium hypophosphite.

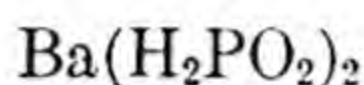


Wurtz, Compt. rend., **18**, 702 (1884)

Ref., Ann. chim. phys., [3], **11**, 250

Ref., Bartlett and Rice, Am. Chem. J., **19**, 50 (1897)

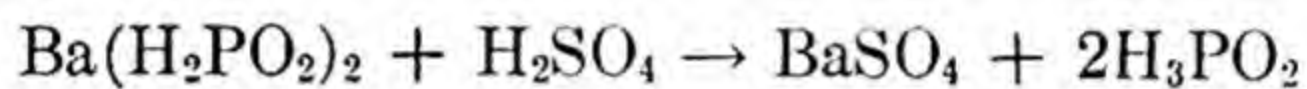
1



H₂SO₄

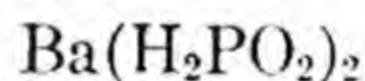
I-2264

Barium hypophosphite in solution reacts with sulfuric acid.



H. Rose, Pogg. Ann., **9**, 370 (1827)

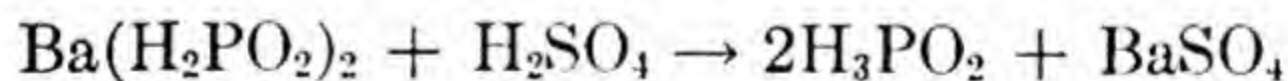
25



H₂SO₄

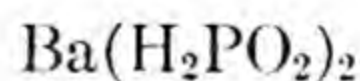
I-2265

Crystalline hypophosphorous acid is formed when equivalent quantities of barium hypophosphite and sulfuric acid are mixed and the liquid decanted from the barium sulfate and concentrated by heating until the temperature of the liquid reaches 130°C. The liquid is filtered into a glass stoppered bottle and cooled to 0°C. M. P. 17.4°C.



Julius Thomson, Ber., **7**, 994 (1874)

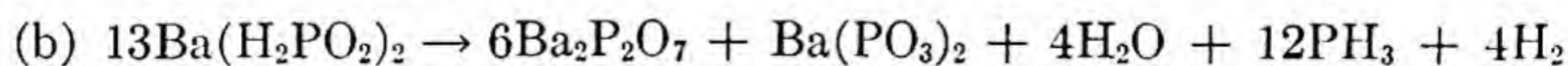
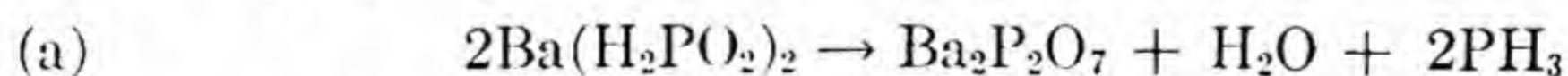
11



Δ

I-2266

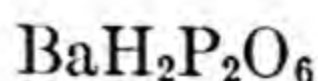
Barium hypophosphite is heated to redness.



Rammelsberg, Ber. Wien. Akad., (2), **69**, (1873)

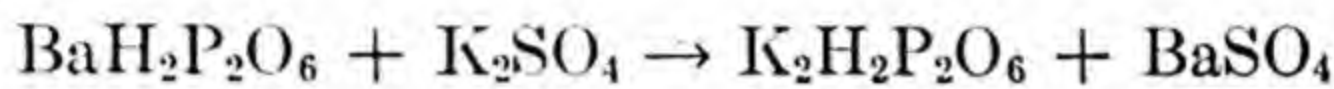
Ref., J. Chem. Soc. (London), **26**, 1 (1873)

25



I-2267

Ten parts of barium dihydrogen hypophosphate is ground fine and mixed with 5.22 parts of potassium sulfate dissolved in 50 to 60 parts of water. This mixture is shaken frequently until the liquid gives no test for sulfates. The solution is then filtered and the filtrate concentrated until crystals begin to form. These are dipotassium dihydrogen hypophosphate and contain three H_2O .

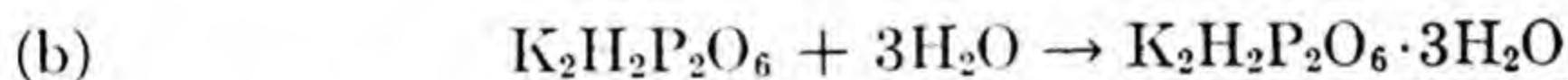
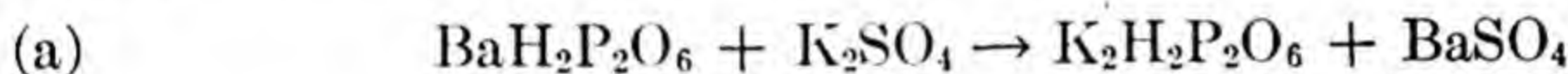
T. Salzer, *Ann.*, **211**, 17 (1882)

20

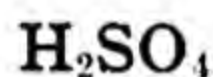


I-2268

Monobarium hypophosphate in powder form will react with a solution of potassium sulfate yielding a solution of dipotassium hypophosphate. By evaporating this solution crystals are obtained.

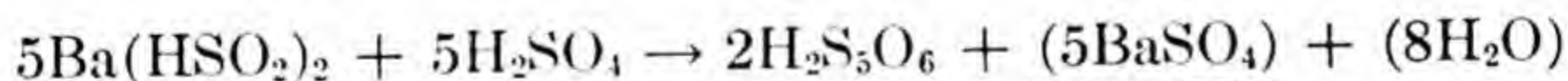
C. Bausa, *Z. anorg. Chem.*, **6**, 128 (1894)

28

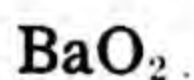


I-2269

Pentathionic acid is formed by decomposing barium hyposulfite with dilute sulfuric acid.

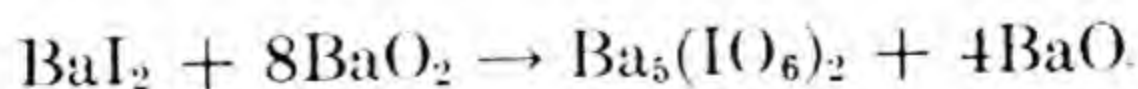
G. Chancel and E. Diacon, *Compt. Rend.*, **56**, 710 (1863)

29



I-2270

Barium iodide is oxidized by heating with barium peroxide.

C. F. Rammelsberg, *Pogg. Ann.*, **134**, 368, 499 (1868)

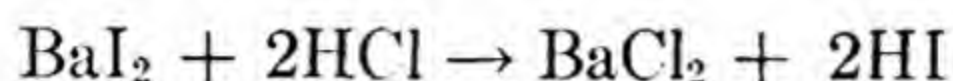
25

BaI₂

HCl

I-2271

Fuming hydrochloric acid forms barium chloride from barium iodide quickly and easily.



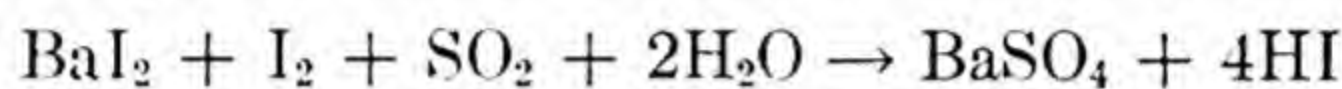
F. Gramp, Ber., 7, 1723 (1874)

11

BaI₂I₂ + SO₂

I-2272

Sulfur dioxide is passed into a solution of barium iodide and iodine.



E. Bodroux, Compt. rend., 142, 279 (1906)

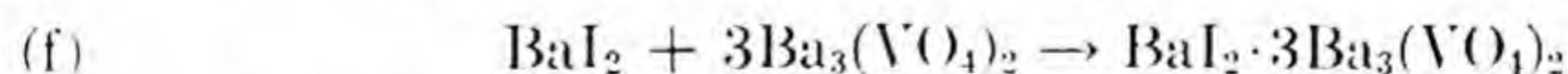
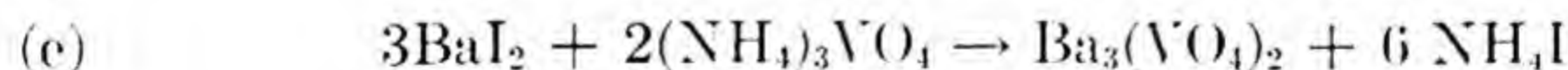
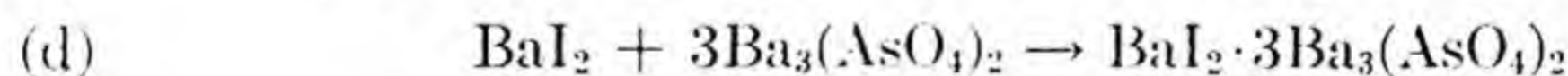
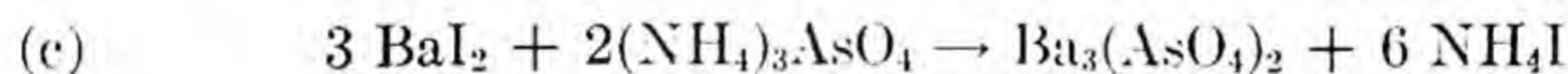
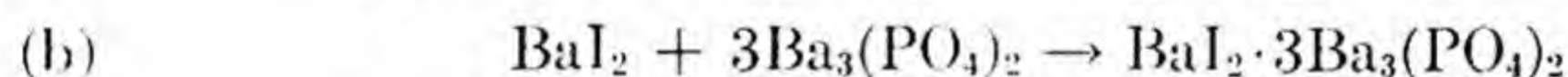
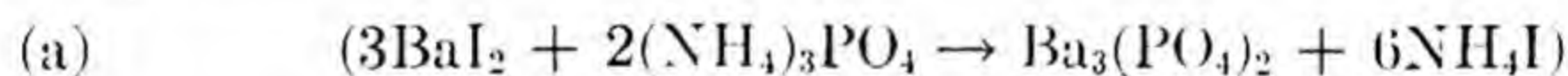
25

BaI₂NaI (NH₄)₃PO₄

I-2273

On fusing a mixture of barium iodide, sodium iodide and a small quantity of ammonium phosphate, followed by slow cooling, hexagonal crystals of barium iodophosphate crystallizes out.

Substitution of ammonium arsenate and vanadate gave the corresponding arsenates and iodovanadates. Similar strontium and calcium compounds were obtained.



A. Ditte, Compt. rend., 96, 1226 (1883)

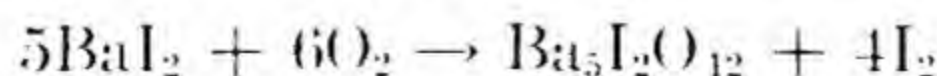
Ref., C. F. M., Science, 2, 407 (1883)

73

BaI₂O₂

I-2274

If barium iodide is heated in a current of dry air until no more iodine is given off, a residue of basic barium periodate is formed.



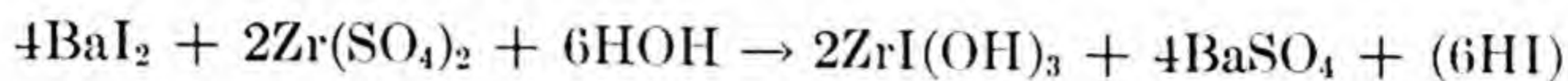
S. Sugiura and C. F. Cross, J. Chem. Soc. (London), 35, 118 (1879)

91



I-2275

A basic zirconium iodide is formed when solutions of barium iodide and zirconium sulfate are mixed and the solution evaporated over concentrated sulfuric acid.



Hinsberg, Ann., **239**, 253 (1887)

Ref., J. Am. Chem. Soc., **18**, 673 (1896)

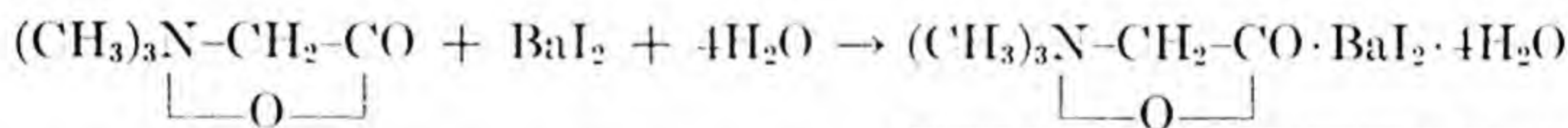
1



Betaine

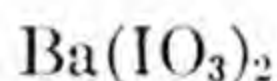
I-2276

When an aqueous solution containing 1 part barium iodide and 1 part betaine is concentrated, betaine barium iodide tetrahydrate precipitates.



W. K. Anslow and H. King, Biochem. J., **22**, 1262 (1928)

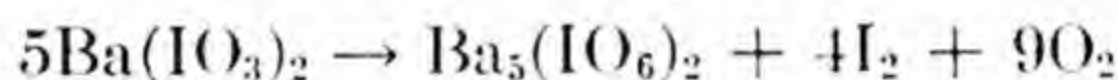
53



Δ

I-2277

Barium iodate is heated to a high temperature.



C. F. Rammelsberg, Pogg. Ann. **137**, 315 (1869)

25



I-2278

Dried barium permanganate was dissolved in water and sulfuric acid added. After concentration in a vacuum, permanganic acid was obtained.



Hunefeld, Schweiggers, J. Chem. Pharm., **30**, 133 (1830)

Ref., Mitscherlich, Pogg. Ann., **25**, 287 (1832)

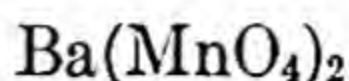
Ref., Thenard, Compt. Rend., **42**, 382 (1856)

Ref., Aschoff, J. prakt. Chem., **81**, 29 (1860)

Ref., Tereil, Chem. News, **6**, 57 (1862)

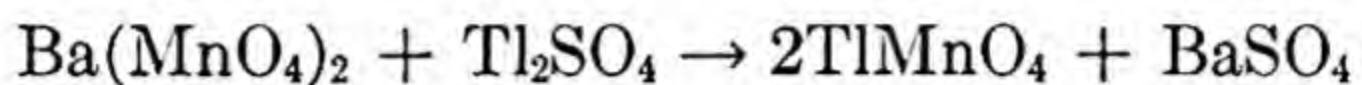
Ref., Muir, J. Chem. Soc. (London), **91**, 1485 (1907)

109


 Tl_2SO_4

I-2279

A solution of barium permanganate will react with a solution of thallous sulfate yielding thallium permanganate. By evaporating the solution black colored, prismatic crystals of thallium permanganate are obtained.



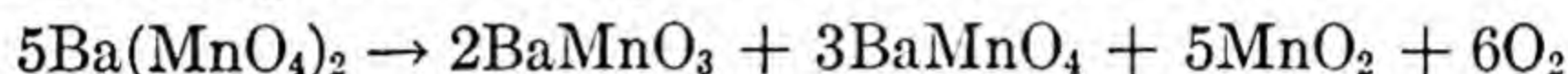
R. J. Meyer and H. Best, *Z. anorg. Chem.*, **22**, 169 (1900)

28

 Δ

I-2280

Barium permanganate decomposes when heated to 220°.



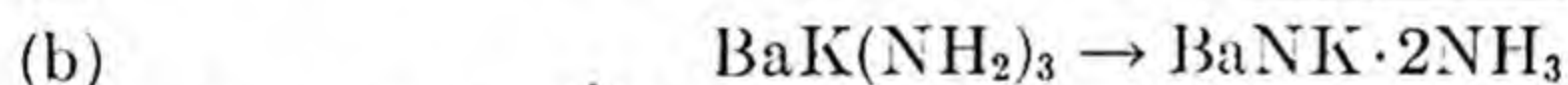
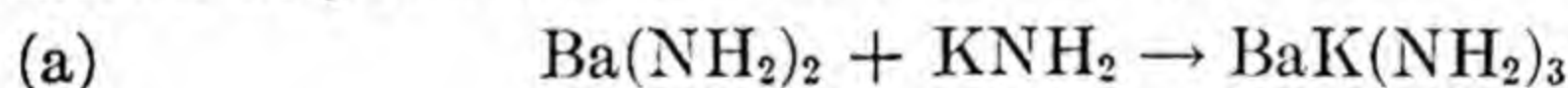
Crespi and Moles, *Anales soc. espan. fis quim.* **20**, 692 (1922)

25


 KNH_2

I-2281

Barium amide reacts with potassium amide in liquid ammonia yielding a precipitate (a), which dissolves in an excess of the precipitant and is known as potassium ammono bariate (b).



E. C. Franklin, *J. Am. Chem. Soc.*, **37**, 2297 (1915)

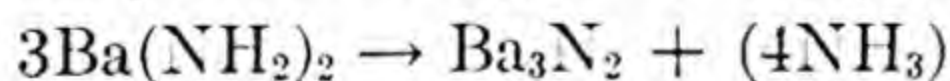
Ref., *ibid*, *J. Phys. Chem.*, **23**, 41 (1919)

85

 Δ

I-2282

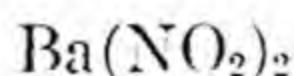
Barium amide decomposes forming barium nitride at 650°.



Guntz and Mentrel, *Bull. Soc. Chim.*, (3), **29**, 585 (1903)

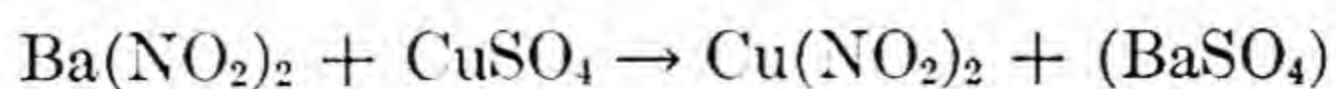
Ref., J. L. Howe, *J. Am. Chem. Soc.*, **25**, 1293 (1903)

1


 CuSO_4

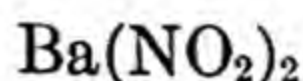
I-2283

Barium nitrite and copper sulfate produce a deep green, almost blackish green, solution of copper nitrite which on evaporation gives a basic nitrate. Similar reactions take place when barium nitrite reacts with sulfates of Cd, Mg, Zn, Co and Ni and with chloride of lead.



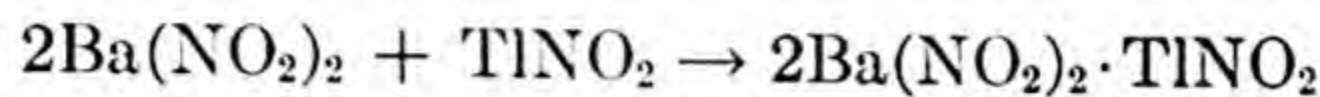
J. Lang, *K. Sv. Vet. Akad. Handl.* **3**, 16 (1860)

10

TiNO₂

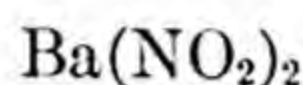
I-2284

A solution containing barium and thallium nitrites (2:1) is evaporated.



Cuttica and Paciello, *Gazz. chim. ital.*, **52**, (1) 141 (1922)

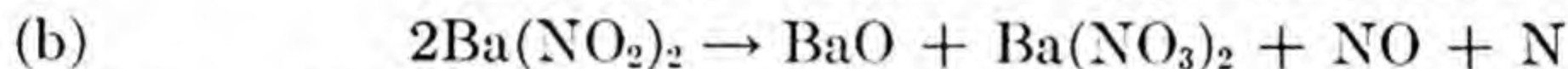
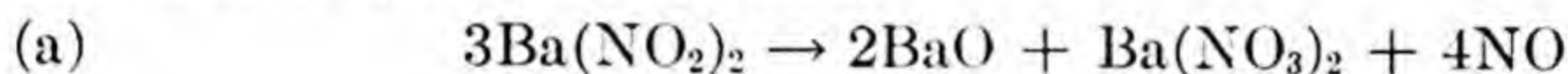
21



Δ

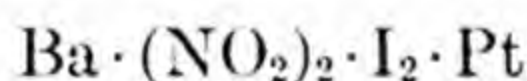
I-2285

(a) When barium nitrite is heated slowly and cautiously, nitrous oxide, barium oxide, and barium nitrate are formed. (b) When this compound is heated more rapidly, nitric oxide, nitrogen, barium oxide and barium nitrate are formed.



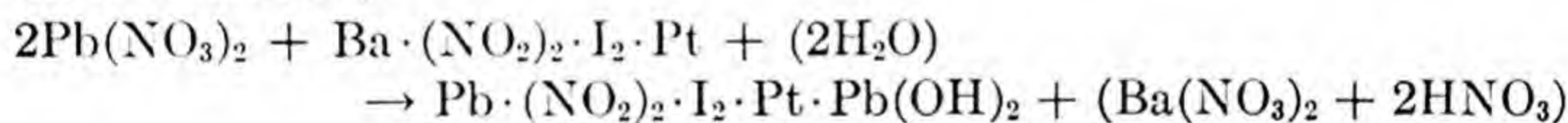
A. C. Gañguli, *J. Chem. Soc. (London)*, **87**, 183 (1905)

102

Pb(NO₃)₂

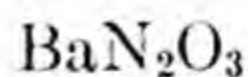
I-2286

Solutions of barium iodine platino-nitrite and lead nitrate precipitate yellow, crystalline lead iodine platino-nitrite. The mercurous salt is formed similarly.



L. F. Nilson, *K. Sv. Vet. Akad. Handl., Öfvers.* **35**, No. 3, 56-58 (1878)

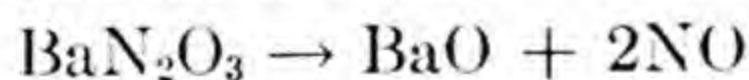
10



Acid

I-2287

The decomposition of BaN₂O₃ with the addition of some mineral acid will give barium oxide and nitric oxide.



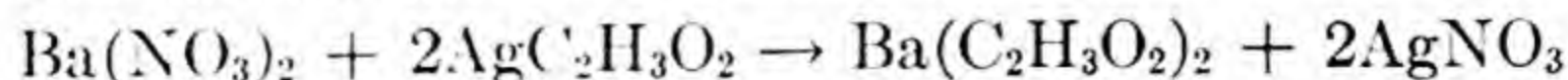
A. Angeli, *Gazz. chim. Ital.* **26**², 20 (1896)

21

AgC₂H₃O₂

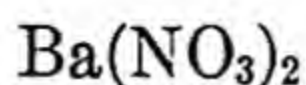
I-2288

A solution of barium nitrate is treated with silver acetate.



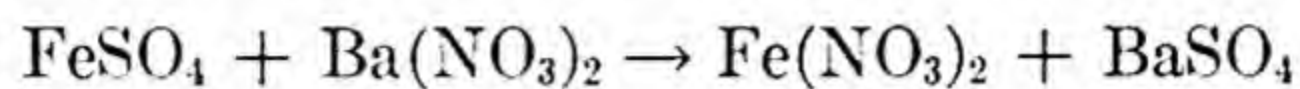
R. Griesbach, *Z. Phys. Chem.*, **97**, 22 (1927)

25



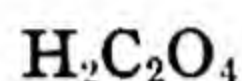
I-2289

Ferrous nitrate solution is prepared by the interaction of a dilute nitric acid solution of ferrous sulfate and an aqueous solution of barium nitrate.



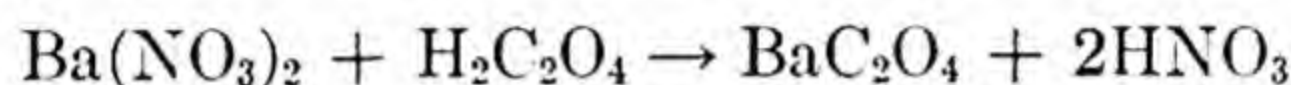
A. A. Noyes and B. F. Braun, J. Am. Chem. Soc., **34**, 1017 (1912)

1



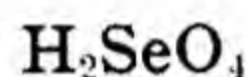
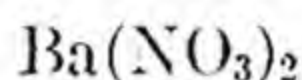
I-2290

A solution of barium nitrate reacts with oxalic acid at 100°.



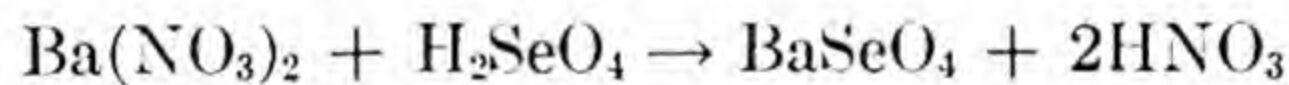
W. Ö. de Conink, Bull. Soc. Chim., **19**, 110 (1916)

25



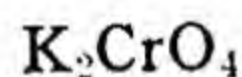
I-2291

Barium selenate precipitates when a solution of barium nitrate is treated with a hot solution of selenic acid.



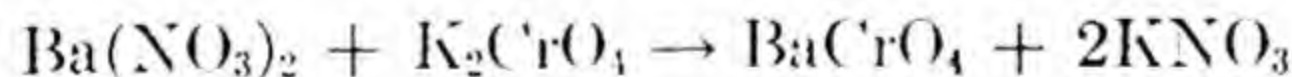
F. C. Mathers and R. S. Bonsib, J. Am. Chem. Soc., **33**, 704 (1911)

1



I-2292

Barium is quantitatively separated from strontium (calcium and magnesium) when the nitrates are treated with sodium acetate and acetic acid, and potassium chromate added until the solution is yellow.



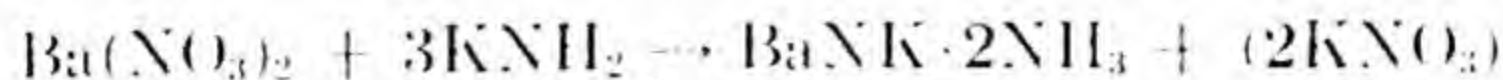
Fr. Frerichs, Ber., **7**, 800 (1874)

11



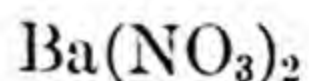
I-2293

A white insoluble precipitate of potassium barium nitride diammoniate is produced when barium nitrate and an excess of potassium amide are brought together in liquid ammonia solution.

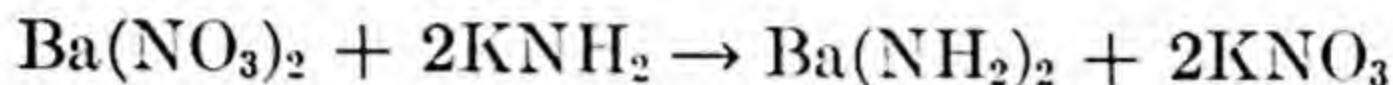


E. C. Franklin, J. Am. Chem. Soc., **37**, 2297 (1915)

1

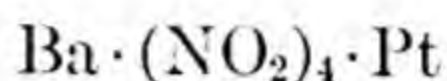
**KNH₂****I-2294**

Barium amide may be formed when two equivalents of potassium amide are added to barium nitrate in liquid ammonia solution.

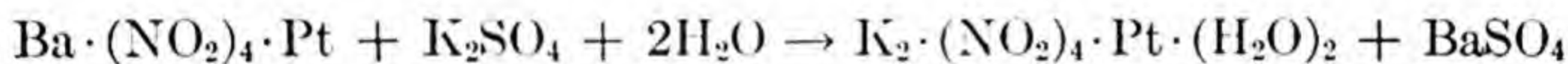


E. C. Franklin, *J. Am. Chem. Soc.*, **37**, 2299 (1915)

1

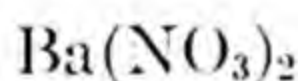
**K₂SO₄****I-2295**

When solutions of barium platinonitrite and potassium sulfate are mixed and the precipitated barium sulfate filtered off, the filtrate yields colorless, oblique, four-sided tablets of dihydrated potassium platinonitrite. Similar method yields corresponding salts (most of them hydrated) of Rb, Cs, NH₄, Tl, Na, Li, Ag, Ca, Mg, Mn, Co, Ni, Cu, Zn, Cd, Al, Y, Er, Ce, La, and Nd.

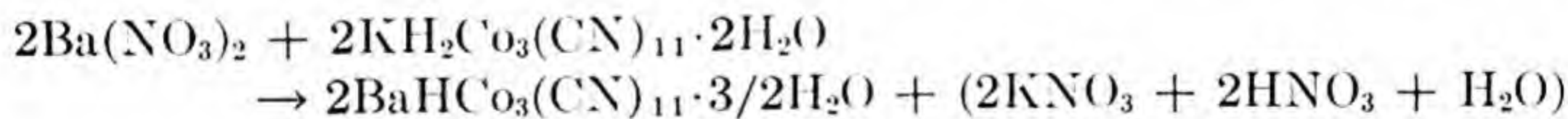


L. F. Nilson, *K. Sv. Vet. Akad. Handl. Öfvers.* **33**, No. 7, 23-30 (1876)

10

**KH₂Co₃(CN)₁₁·H₂O****I-2296**

Baric cobaltocobalticyanide is made by adding an excess of barium nitrate or chloride to a solution of monopotassic cobaltocobalticyanide.



Jackson and Comey: *Am. Chem. J.*, **19**, 275 (1897)

1

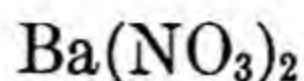
**Na₃H₂IO₆****I-2297**

Barium periodate is formed when trisodium paraperiodate is treated with barium nitrate.



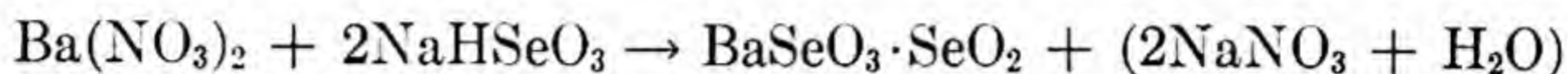
H. H. Willard and J. J. Thompson, *J. Am. Chem. Soc.*, **56**, 1828 (1934)

1



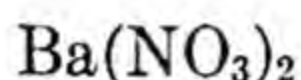
I-2298

When solutions of barium nitrate and of sodium hydrogen selenite are mixed, the solution yields barium selenite selenium dioxide as radiated masses of small, four-sided prisms.



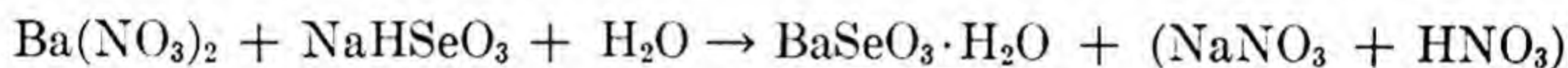
L. F. Nilson, K. Sv. Vet. Akad. Handl. Öfvers., **31**, No. 1, 38 (1874)

10



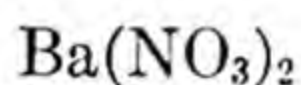
I-2299

Slow precipitation from barium nitrate and sodium hydrogen selenite solutions yields mono-hydrated normal barium selenite as small prisms.



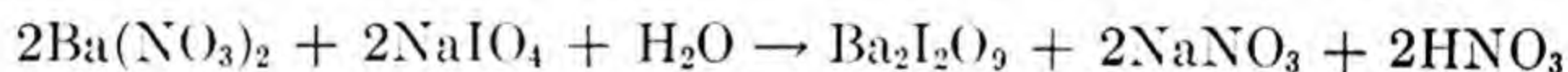
L. F. Nilson, Nova. Act. Reg. Soc. Sci. Upsal., Series 3, Vol. **9**, No. 7, 39 (1874)

10



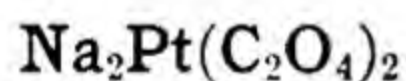
I-2300

A solution of barium nitrate is treated with sodium periodate.



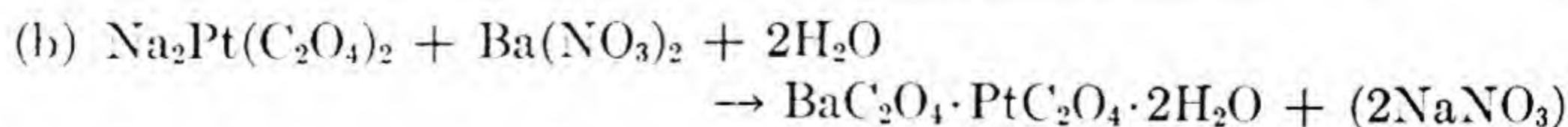
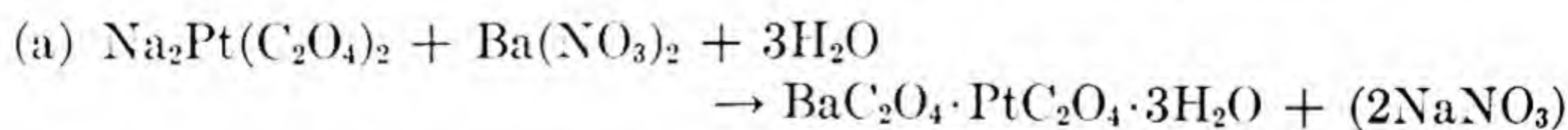
C. F. Rammelsberg, Pogg. Ann., **134**, 391

25



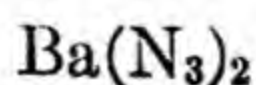
I-2301

From barium nitrate solution sodium platino-oxalate produces hydrated barium platino-oxalate. The dark sodium salt gives the 1:1:3 product as a dark green to greenish brown amorphous precipitate, and the light gives the 1:1:2 product as orange-red, microscopic crystals.



H. G. Söderbaum, K. Sv. Vet. Akad. Handl., Öfvers. **42**, No. 10, 32-33 (1885)

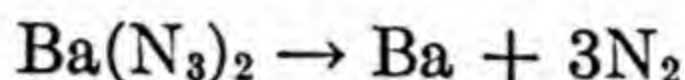
10



UV Light

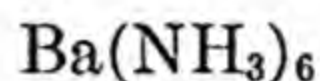
I-2302

When barium triazide is irradiated with ultra-violet light of less than 2360 Å, nitrogen is evolved and nuclei of metallic barium are formed.



W. E. Garner and J. Maggs, *Proc. Roy. Soc. (London)*, **172A**, 299 (1939)

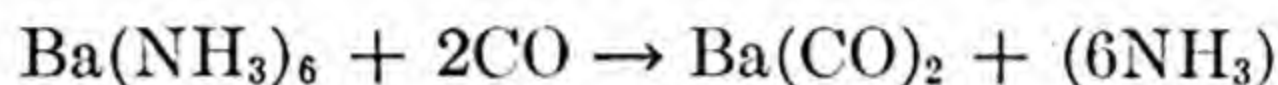
110



CO

I-2303

Barium carbonyl is formed as a yellow, fairly stable compound by action of carbon monoxide upon barium hexammoniate.



Guntz and Mentrel, *Bull. Soc. Chim.*, (3), **29**, 585 (1903)

Ref., J. L. Howe, *J. Am. Chem. Soc.*, **25**, 1293 (1903)

1



Δ

I-2304

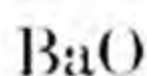
Barium hexammoniate decomposes at temperatures above -23° , forming barium amide.



Guntz and Mentrel, *Bull. Soc. Chim.*, (3), **29**, 585 (1903)

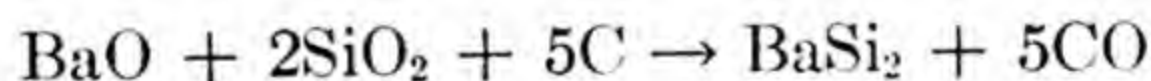
Ref., J. L. Howe, *J. Am. Chem. Soc.*, **25**, 1293 (1903)

1

C + SiO₂

I-2305

Barium oxide is mixed with sand and carbon and heated in the electric furnace.



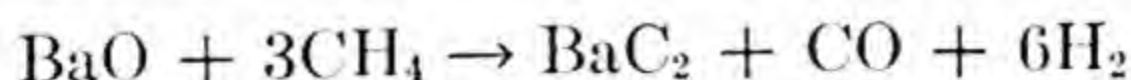
Bradley, *Chem. News*, **82**, 149 (1900)

25

CH₄

I-2306

When methane at 15 mm. is passed over barium oxide heated to 1050–1200°C, barium carbide, carbon monoxide and hydrogen are formed.



Franz Fischer, *Brennstoff-Chem.*, **9**, 331 (1928)

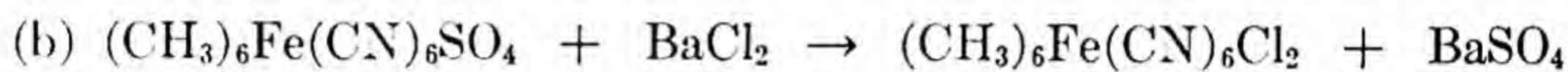
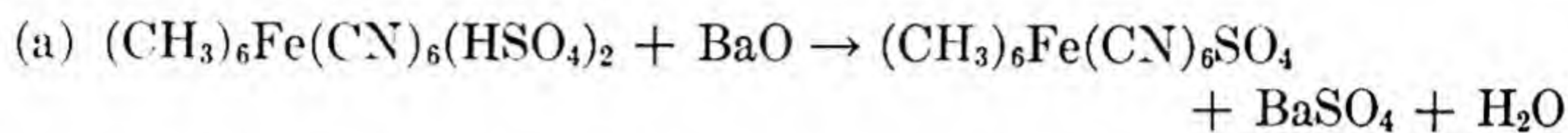
11

BaO



I-2307

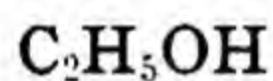
When an aqueous solution of hexamethylferrocyanide hydrogen sulfate is neutralized with barium oxide, the corresponding normal sulfate is produced. Addition of barium chloride produces hexamethyl ferrocyanogen chloride.



E. G. J. Hartley: J. Chem. Soc. (London), **97**, 1728 (1910)

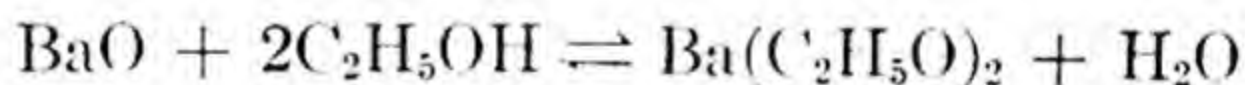
57

BaO



I-2308

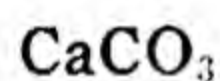
Barium oxide has been shown to be superior to calcium oxide for the small-scale dehydration of alcohol. However, the dehydrated ethyl alcohol thus obtained is only 99.5 per cent in strength as a result of the reversal of the dehydration reaction through the formation of barium ethoxide.



G. Frederick Smith and C. A. Getz, Ind. Eng. Chem., Anal. Ed., **9**, 100 (1937)

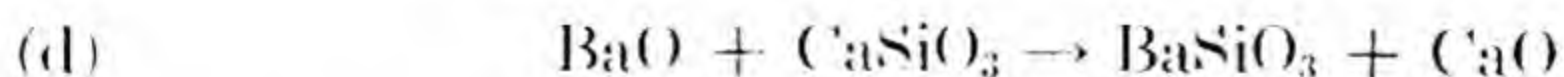
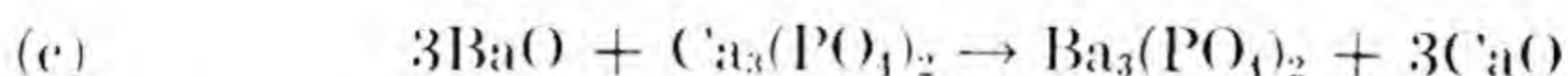
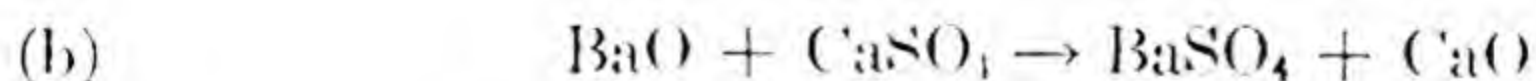
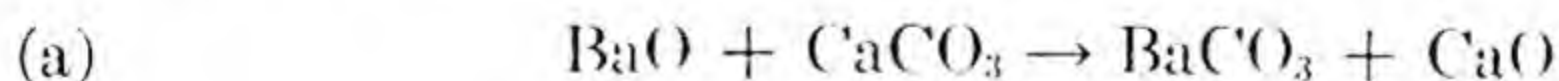
44

BaO



I-2309

Barium monoxide when heated with calcium carbonate yields barium carbonate and calcium oxide. It behaves similarly with calcium sulfate, normal phosphate, and silicate. Strontium oxide may be substituted for barium oxide in all four cases.



J. A. Hedvall, Sv. Kem. Tidskr., **40**, 67 (1928)

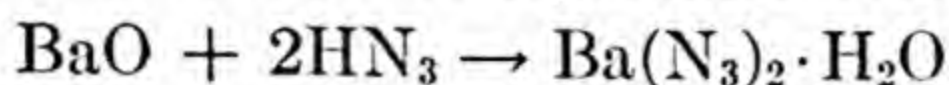
10

BaO

HN₃

I-2310

Barium triazide is formed when barium oxide is dissolved in a solution of triazoic acid and allowed to crystallize over sulfuric acid.



Dennis and Benedict, *J. Am. Chem. Soc.*, **20**, 229 (1898)

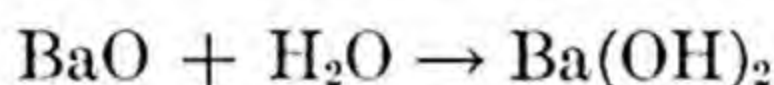
1

BaO

H₂O

I-2311

Barium monoxide reacts with water and yields barium hydroxide.



J. A. Hedvall, *Ark. Kem., Min., Geol.*, **7**, Part 14, 2 (1918)

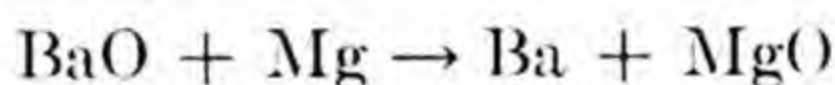
10

BaO

Mg

I-2312

An energetic reaction occurs when barium oxide is reduced by magnesium in the presence of hydrogen.



H. F. Keller, *J. Am. Chem. Soc.*, **16**, 837 (1894)

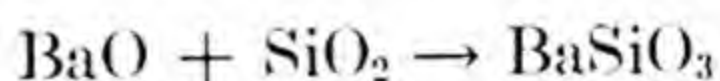
1

BaO

SiO₂

I-2313

Barium oxide is heated to 1368° with silicon dioxide.



G. Stein, *Univ. Goettingen Diss.*

25

BaO

O₂

I-2314

Δ

Barium oxide, when heated reacts with oxygen from the air forming barium peroxide. Upon heating to a higher temperature, barium peroxide decomposes producing oxygen and barium oxide.



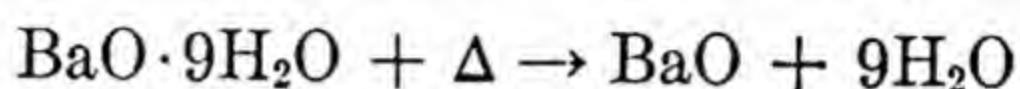
Boussingault, *Ann. Chim. Phys.*, (3) **35**, 5 (1852)

22

$\text{BaO} \cdot 9\text{H}_2\text{O}$ Δ

I-2315

Barium oxide nonahydrate readily forms the dihydrate at relatively low temperatures. Heated at $90-5^\circ$ in a current of hydrogen, both the nonahydrate and the dihydrate form the monohydrate, which will yield the anhydrous oxide if heated to 780° for two to three hours.



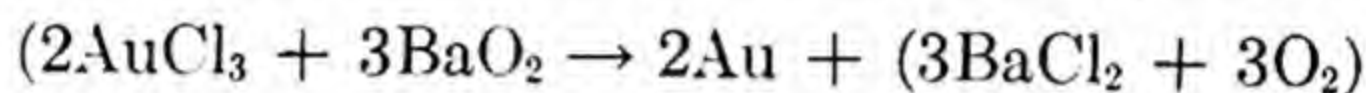
De Forcrand, *Compt. rend.*, **147**, 166 (1908)

38

 BaO_2 AuCl_3

I-2316

Barium peroxide precipitates metallic gold from gold solutions.



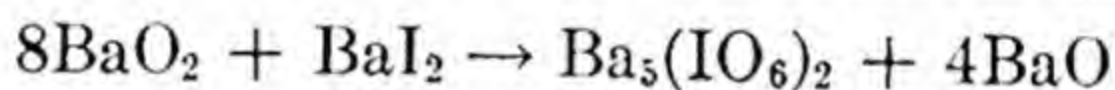
V. Lenher, *J. Am. Chem. Soc.*, **36**, 1424 (1914)

1

 BaO_2 BaI_2

I-2317

A mixture of barium peroxide and barium iodide is heated.



C. F. Rammelsberg, *Pogg. Ann.*, **44**, 577 (1838)

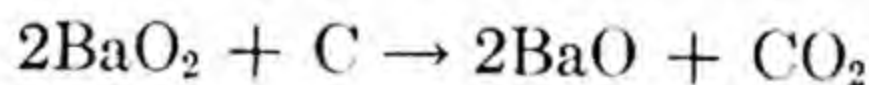
25

 BaO_2

C

I-2318

Barium peroxide is reduced by heating to redness with carbon.



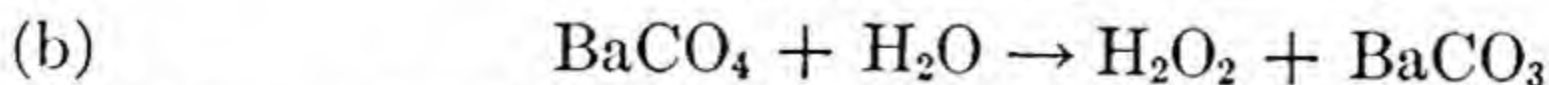
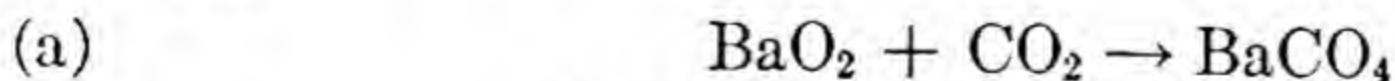
Korda, *Compt. rend.*, **120**, 615

25

 BaO_2 CO_2

I-2319

A 30% solution of barium dioxide at 0° slowly saturated with carbon dioxide, reacts to form barium percarbonate (barium dioxide carbonate). Excess water will cause this product to decompose liberating hydrogen peroxide.



R. Wolfenstein and E. Peltner, *Ber.*, **41**, 275 (1908)

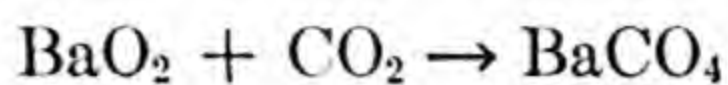
Ref.: W. Robertson, *J. Chem. Soc. (London)*, **94**, [2], 183 (1908)

57

CO₂

I-2320

Barium percarbonate is formed when carbon dioxide is passed into a suspension of barium peroxide in water at 30°.



Merck, Ger. Pat., 178,019 (1905)

Ref., R. Wolffenstein and E. Peltner, Ber., **41**, 275 (1908)

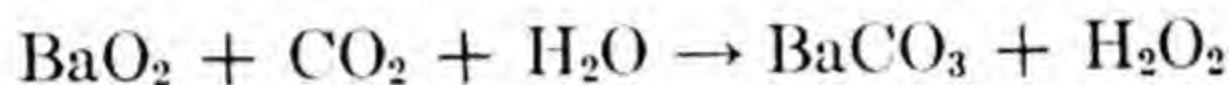
25

CO₂

I-2321

H₂O

Pure hydrogen peroxide is formed by passing a rapid current of carbon dioxide through distilled water to which barium peroxide is added from time to time.



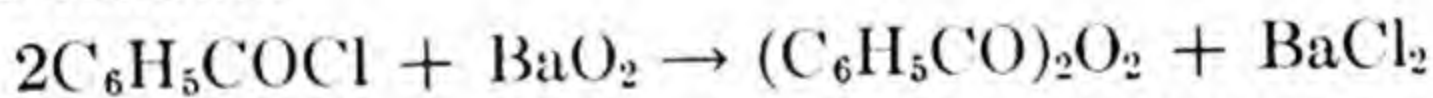
F. Duprey, Compt. Rend., **55**, 736 (1862)

29

C₆H₅COCl

I-2322

Dibenzoyl peroxide may be prepared by the reaction of benzoyl chloride with barium peroxide in the presence of water. The reaction may be expressed as follows:



C. G. Ferrari and C. H. Bailey, Cereal Chem., **6**, 473 (1929)

98

ClO₂

I-2323

Chlorine dioxide (chlorine-free) mixed with carbon dioxide is passed into a solution of barium peroxide.



Bruni and Levi, Atti. ist. Veneto sci. let. Arti II, **74**, 1711

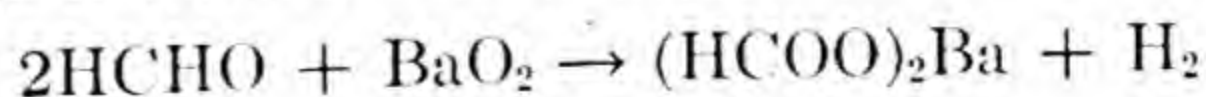
25



HCHO

I-2324

Barium formate is the most probable compound formed when barium peroxide is treated with neutral formaldehyde.



C. A. Lyford, J. Am. Chem. Soc., **29**, 1229 (1907)

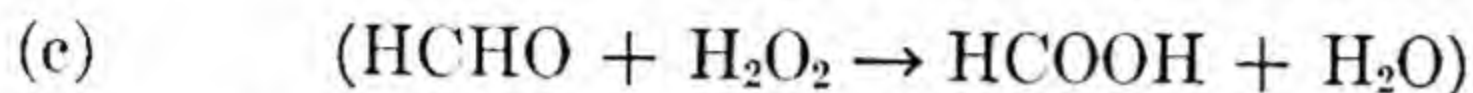
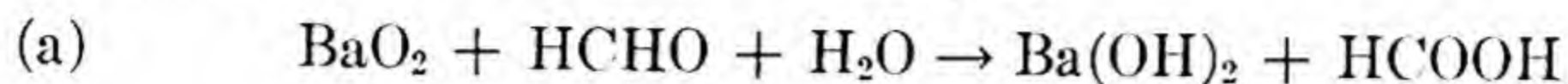
1



HCHO

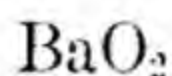
I-2325

Barium peroxide oxidizes formaldehyde.



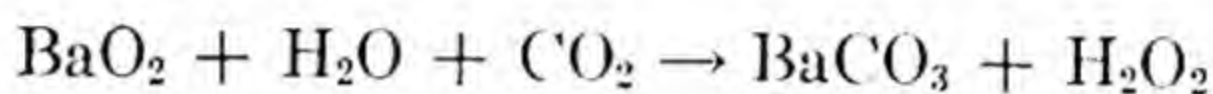
C. A. Lyford, J. Am. Chem. Soc., **29**, 1227 (1907)

25

H₂CO₃

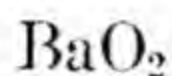
I-2326

Hydrogen dioxide may be prepared by slowly adding barium dioxide to a carbonic acid solution.



H. A. Doerner, Chem. Met. Eng., **26**, 1111 (1922)

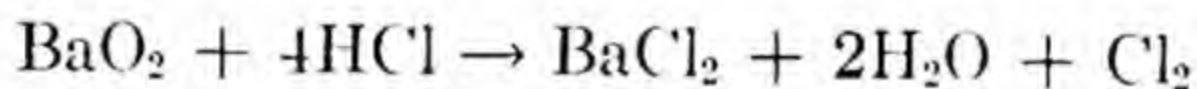
44



HCl

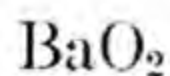
I-2327

Barium peroxide is converted into barium chloride by its reaction with hydrochloric acid gas.



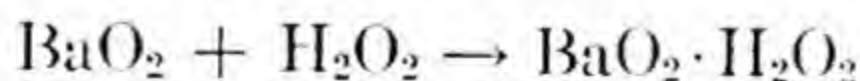
M. C. Weltzien, Chem. News, **14**, 50 (1866)

101

H₂O₂

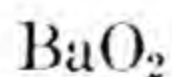
I-2328

An aqueous solution of barium peroxide is treated with an excess of hydrogen peroxide in the presence of ammonium hydroxide. Crystals of barium peroxyhydrate soon separate.



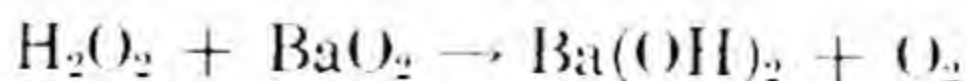
E. Schone, Ann., **192**, 272 (1878)

20

H₂O₂

I-2329

An excess of barium dioxide will cause decomposition and loss of hydrogen dioxide.

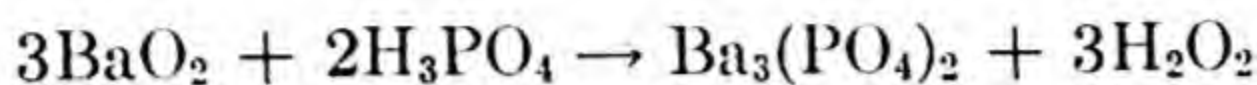


H. A. Doerner, Chem. Met. Eng., **26**, 1111 (1922)

44

H₃PO₄**BaO₂****I-2330**

A suspension of barium peroxide in cold water is treated with phosphoric acid.

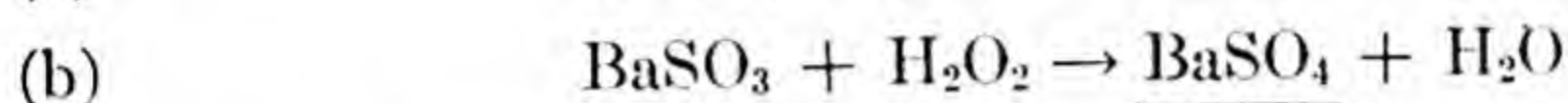
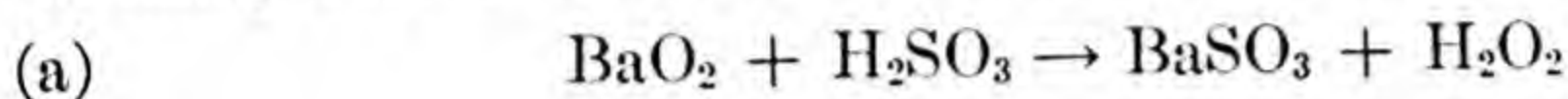


F. Cobellis, U. S. Pat. 1,273,824 (1918)

25

BaO₂**H₂SO₃****I-2331**

Barium peroxide is added to a cold dilute solution of sulfurous acid.



L. Marino, Z. Anorg. Chem., **56**, 233

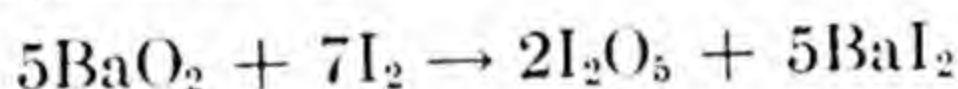
25

Ref., L. Marino, Gazz. Chim. Ital., **38**¹, 269 (1908)

21

BaO₂**I****I-2332**

Barium peroxide and excess iodine are ground together until the mixture is black, then placed in retort and heated.

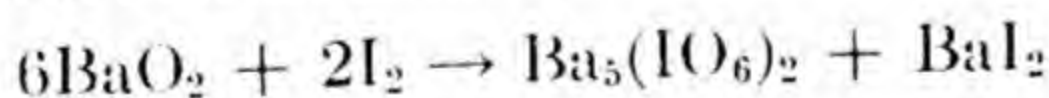


No Author given, Ann., **4**, 170 (1832)

20

BaO₂**I****I-2333**

Barium peroxide reacts with iodine.

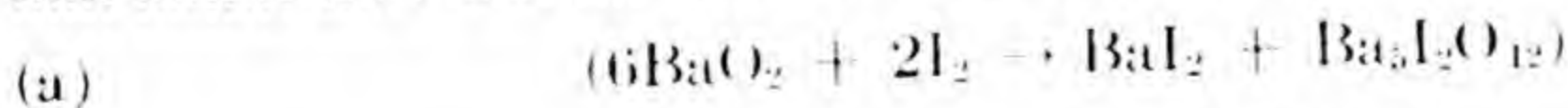


C. F. Rammelsberg, Pogg. Ann., **44**, 577 (1838)

25

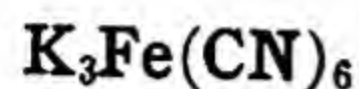
BaO₂**Δ****I-2334****I₂**

When barium peroxide and an excess of iodine are heated together, barium iodide and barium oxide and barium paraiodate are formed.



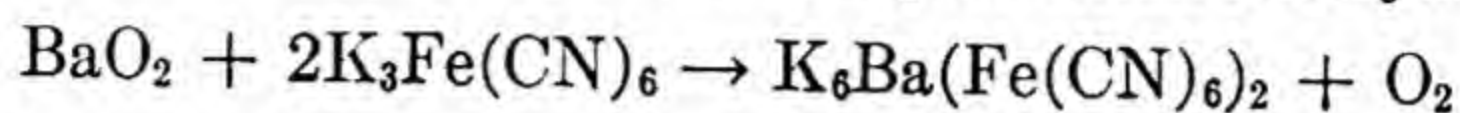
C. Rammelsberg, Ber., **2**, 148 (1869)

11



I-2335

Barium peroxide is added to a solution of potassium ferricyanide.



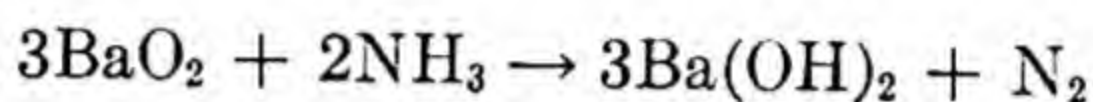
Kwasnik, Ber., **25**, 67 (1892)

25



I-2336

Barium peroxide is reduced by heating to a high temperature in the presence of ammonia.



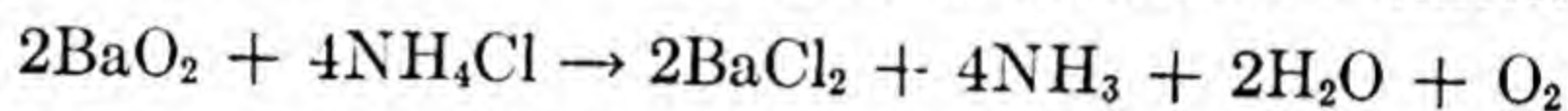
Michel and Grandmougin, Ber., **26**, 2567 (1893)

25



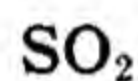
I-2337

Barium peroxide is added to a solution of ammonium chloride.



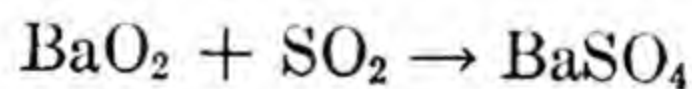
Santi, Boll. Chim. Farm., **43**, 673

25



I-2338

Barium sulfate is produced by the reaction of sulfur dioxide on barium dioxide.



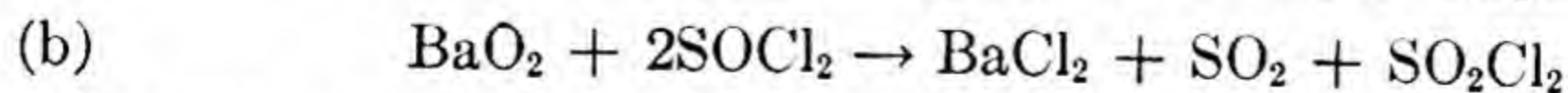
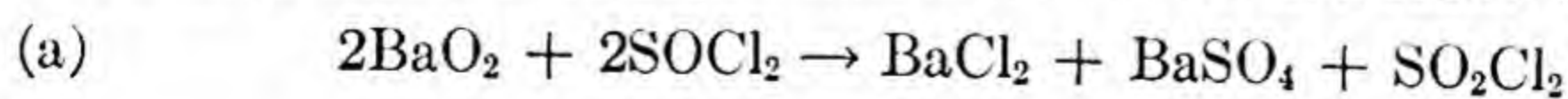
E. J. Russell and N. Smith, J. Chem. Soc. (London) **77**, 345 (1900)

102



I-2339

Barium chloride and sulfur dioxide are formed when barium peroxide and a large excess of thionyl chloride are heated in a sealed tube.

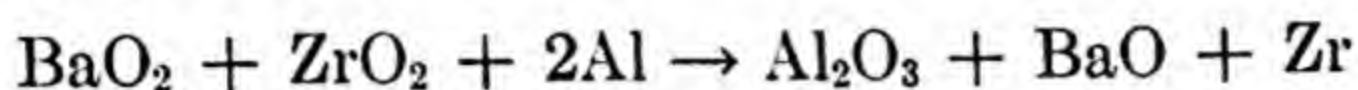


North and Hageman, J. Am. Chem. Soc., **35**, 544 (1913)

1

ZrO₂ + Al**BaO₂****I-2340**

A mixture of barium peroxide, zirconium oxide and aluminum is heated to a high temperature.

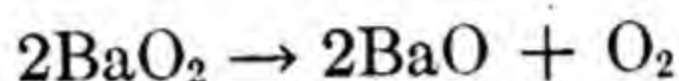


K. A. Kuhne, U. S. Pat. 910,394 (1909)

25

BaO₂**Δ****I-2341**

Barium dioxide melts at bright red heat, and decomposes into barium oxide and oxygen.

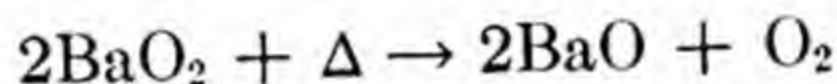


Em. Schöne, Ber., 6, 1174 (1873)

11

BaO₂**Δ****I-2342**

Heat decomposes barium peroxide leaving barium monoxide and evolving oxygen.

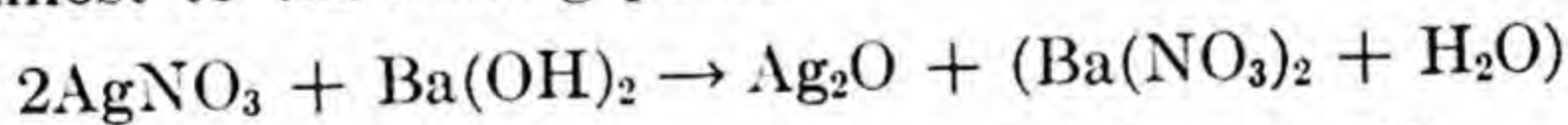


J. A. Hedvall, Ark. Kem., Min., Geol., 7, Part 14, 1 (1918)

10

Ba(OH)₂**AgNO₃****I-2343**

Silver oxide is precipitated when silver nitrate solution and barium hydroxide are dropped simultaneously into a liter of conductivity water heated almost to the boiling point.

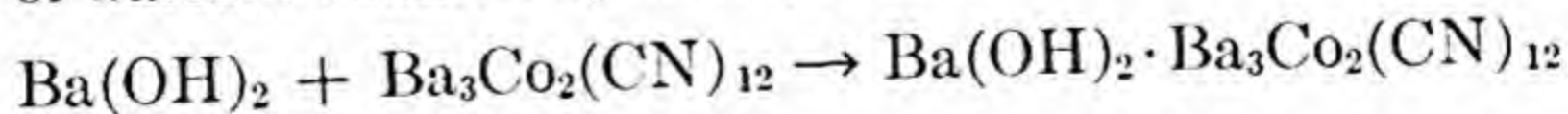


Johnston, Cuta and Garrett, J. Am. Chem. Soc., 55, 2312 (1933)

1

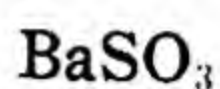
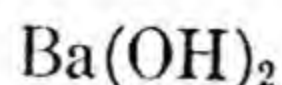
Ba(OH)₂**Ba₃Co₂(CN)₁₂****I-2344**

When a clear solution of barium hydroxide is treated with an excess solution of barium cobaltic cyanide, a basic salt is formed.



P. Weselsky, Ber., 2, 595 (1869)

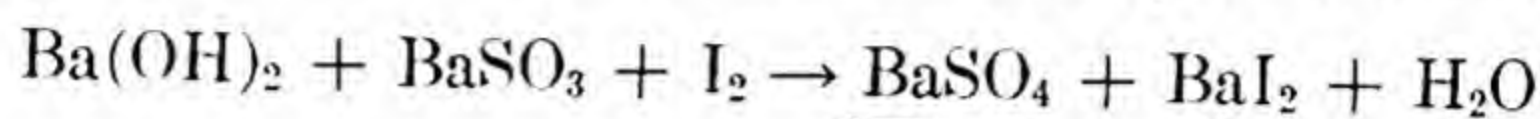
11



I-2345

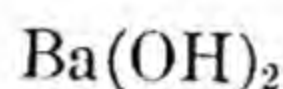


Barium sulfite is oxidized by iodine in barium hydroxide solution.



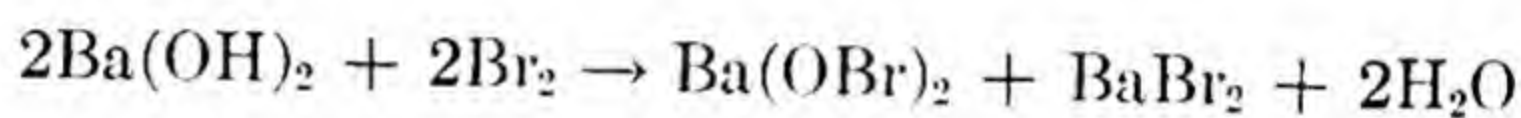
Wagners Jber. (1862) p. 260

25



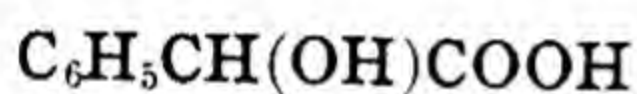
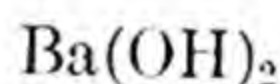
I-2346

When bromine is added to a solution of barium hydroxide, barium hypobromite is formed.



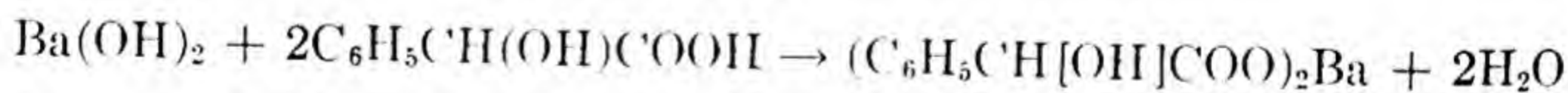
W. Knop, Ber., **3**, 92 (1870)

11



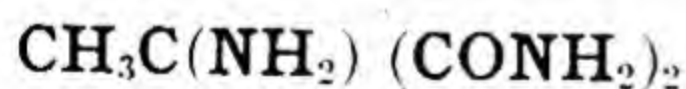
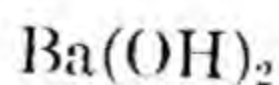
I-2347

Mandelic acid was determined quantitatively by extraction from solution with acidified ether, evaporation of the ether extract, and titration of the residue, dissolved in neutral alcohol with 1N barium hydroxide using phenolphthalein as indicator.



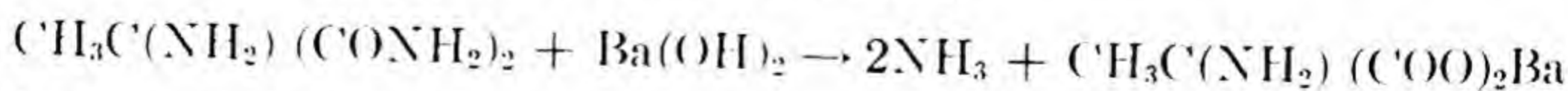
Stevens and Hughes, J. Am. Pharm. Assoc., **28**, 222 (1939)

112



I-2348

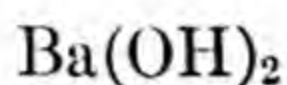
When aminoisosuccinamide is boiled with barium hydroxide, barium aminoisosuccinate and ammonia are formed.



Körner and Menozzi, Gazz. Chim. ital., **17**, 426 (1887)

Ref., P. Latham, Biochem. J., **3**, 209 (1908)

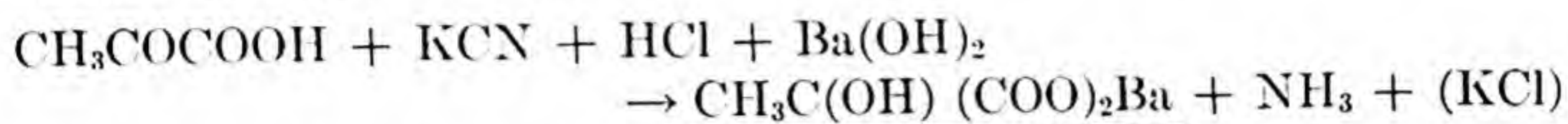
53



I-2349



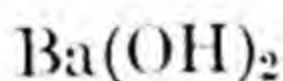
Pyruvic acid is heated with potassium cyanide; concentrated hydrochloric acid is added, and the mixture is poured into a hot solution of barium hydroxide. On cooling, the solution deposits white crystals of barium methyl-tartronate.



C. Böttinger, Ber., **17**, 144 (1884)

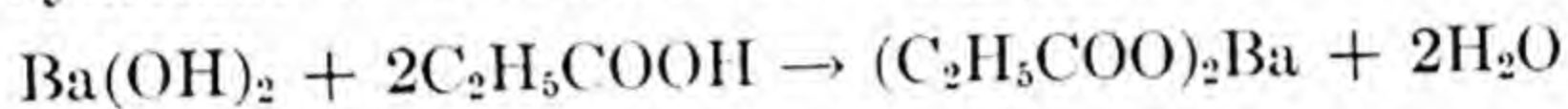
Ref., P. Latham, Biochem. J., **3**, 193 (1908)

53



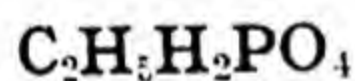
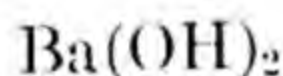
I-2350

Barium hydroxide in solution reacts with propionic acid.



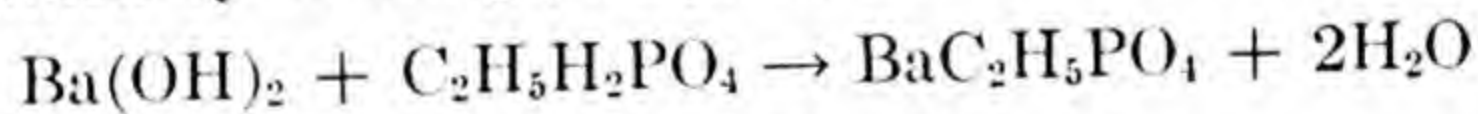
Wing and Thompson, J. Am. Chem. Soc., **48**, 104 (1926)

25



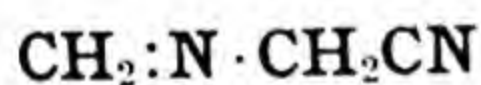
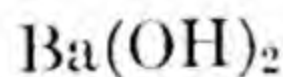
I-2351

Barium hydroxide solution reacts with ethyl dihydrogen orthophosphate, obtained by treating phosphoryl chloride with ethyl alcohol.



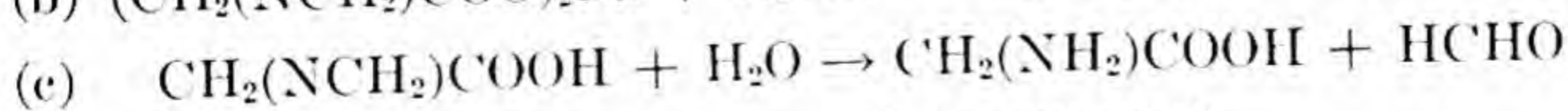
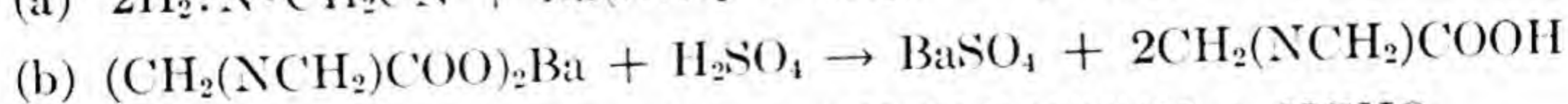
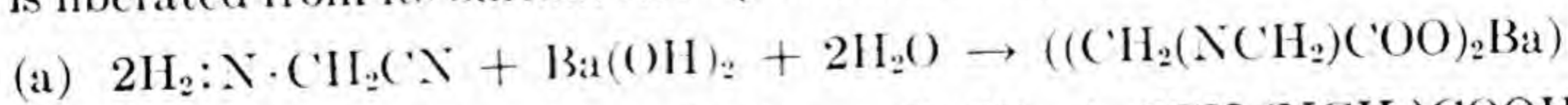
Von D. Balarew, Z. anorg. Chem., **101**, 225 (1917)

25



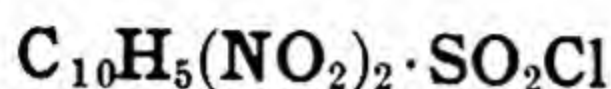
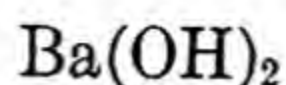
I-2352

Methylene-aminoacetonitrile is completely hydrolyzed to glycine by boiling with a 40% solution of barium hydroxide. The free amino acid is liberated from its barium salt by sulfuric acid.



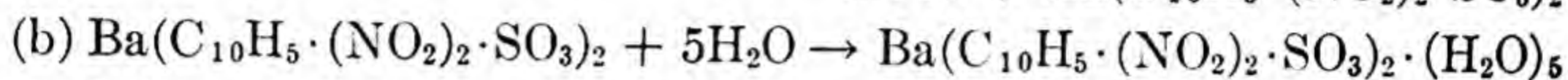
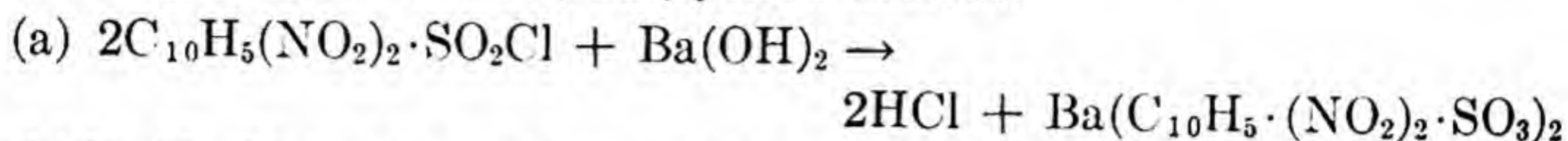
A. R. Ling and D. R. Nanji, Biochem. J., **16**, 702 (1922)

53

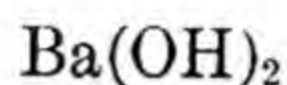


I-2353

Double decomposition between barium hydroxide and dinitronaphthalenesulfonic acid-chloride yields hydrochloric acid and a solution from which the pentahydrated barium salt of dinitronaphthalenesulfonic acid crystallizes as small, flat, yellow needles.

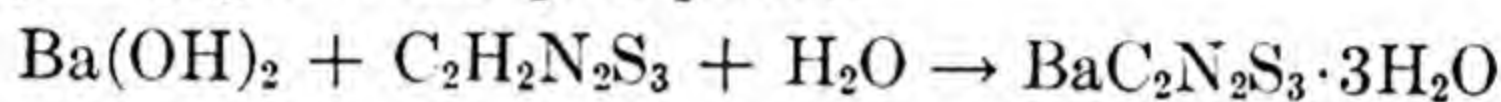


P. Hellström, K. Sv. Vet. Akad. Handl. Bihang., **16**, II, No. 3, 41-43 (1890) 10

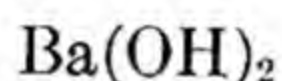


I-2354

Barium hydroxide will react with xanthane hydrogen at higher temperatures yielding a white precipitate.

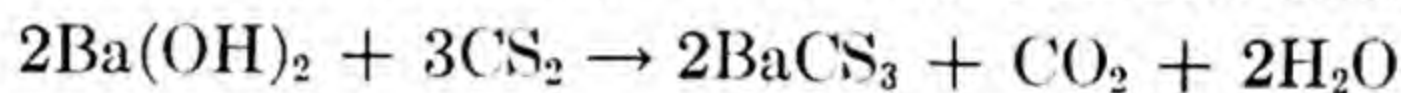


J. V. Dubsky, A. Okac and J. Trtilek., Z. anal. Chem., **100**, 416 (1935) 28

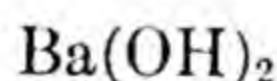


I-2355

Barium hydroxide solution at 50° reacts with carbon disulfide.



Wilhelm Mang, Rev. gin mat. plastiques, **2**, 357 (1926) 25

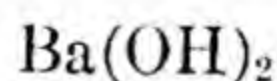


I-2356

Barium hydroxide solution at 100° reacts with carbon disulfide.



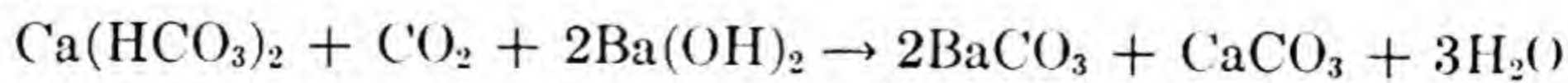
Chancel and Parmentier, Compt. rend., **99**, 892 (1887) 25



I-2357

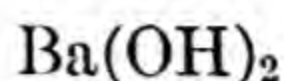


Barium hydroxide precipitates carbonic acid as calcium carbonate from natural water.



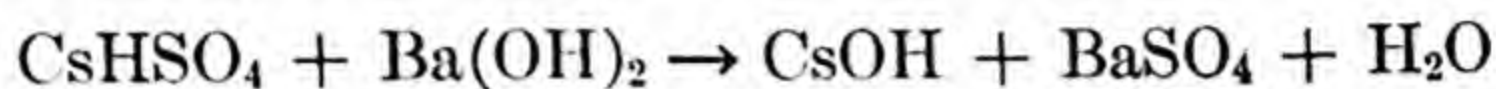
Pettenkofer, N. Rep. Pharm., **10**, 1

Ref., J. Am. Chem. Soc., **23**, 409 (1901) 1



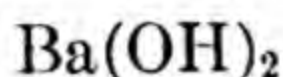
I-2358

A solution of cesium acid sulfate is treated with barium hydroxide.



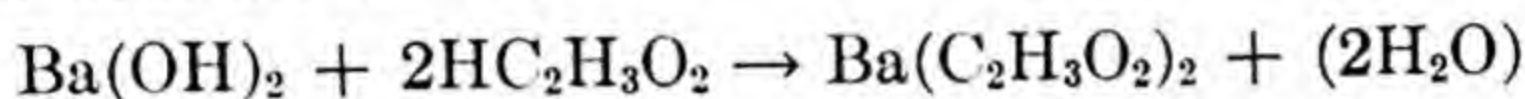
McCrosky and Buell, J. Am. Chem. Soc., **42**, 1786 (1920)

1



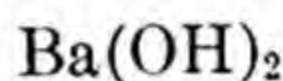
I-2359

Barium acetate is produced when a solution of barium hydroxide is neutralized with acetic acid.



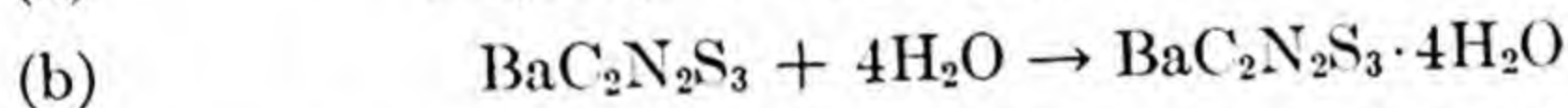
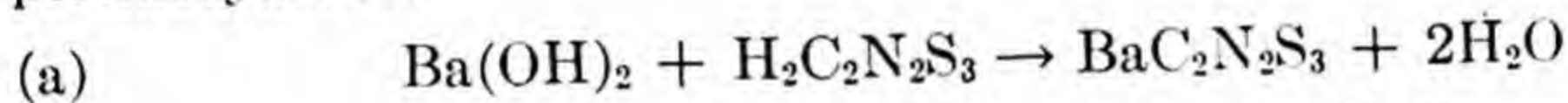
L. H. Duschak, J. Am. Chem. Soc., **30**, 1828 (1908)

1



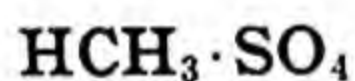
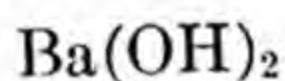
I-2360

When barium hydroxide is treated with perthiocyanic acid and the mixture heated, the yellowish brown solution yields, after recrystallization from water solution, white microscopic needles of tetrahydrated barium perthiocyanate.



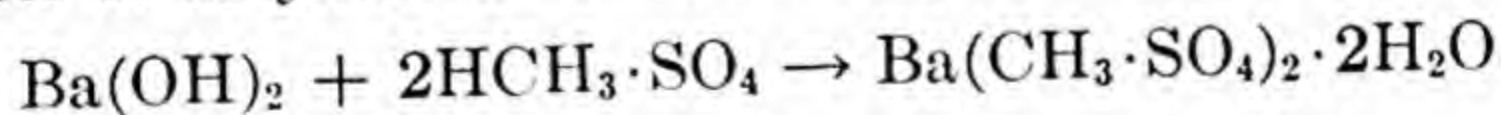
P. Klason, K. Sv. Vet. Akad. Handl. Bihang. **14**, II, No. 7, 9-13 (1888)

10



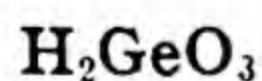
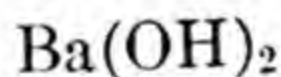
I-2361

Barium hydroxide neutralized with methyl sulfuric acid yields four-sided tablets of dihydrated barium methyl sulfate.



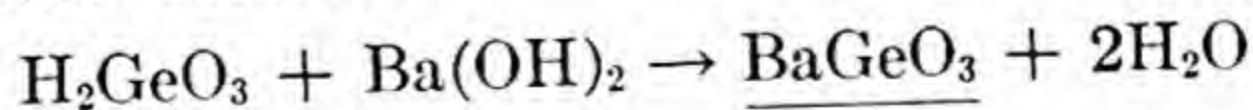
J. E. Alén, K. Sv. Vet. Akad. Handl., Öfvers., **37**, No. 8, 12 (1880)

10



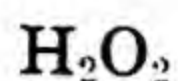
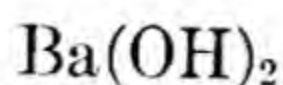
I-2362

Barium germanate is precipitated when germanic acid is treated with barium hydroxide solution.



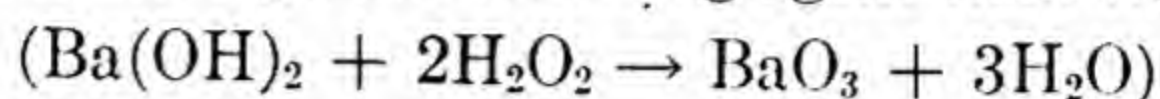
Muller and Gulezian, J. Am. Chem. Soc., **51**, 2040 (1929)

1



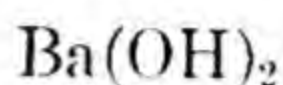
I-2363

An excess of hydrogen peroxide acting on an aqueous solution of barium hydroxide below 20° C. produces a white peroxide which turns buff on standing and is a more vigorous oxidizing agent than BaO₂.



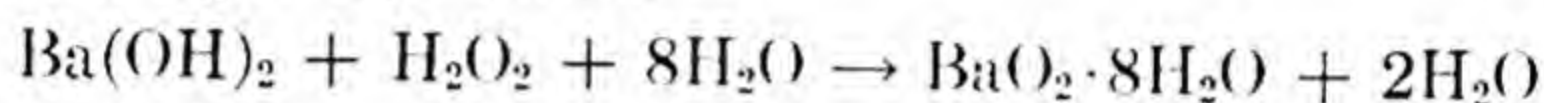
Carlton, Chem. and Ind., **44**, 1047 (1925)

63



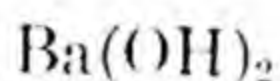
I-2364

A solution of barium hydroxide is treated with hydrogen peroxide at room temperature, either with or without ammonia, in a stoppered flask for 24 to 48 hours. The mixture is allowed to stand and barium peroxide with eight H₂O forms.



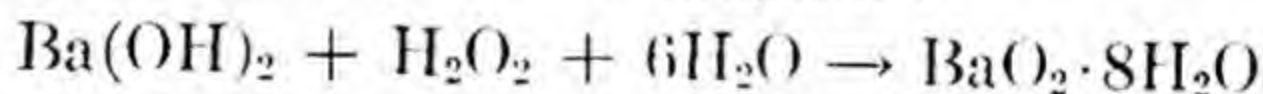
E. Schone, Ann., **192**, 270 (1878)

20



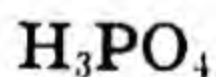
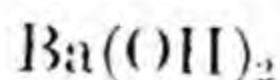
I-2365

Barium hydroxide reacts with hydrogen peroxide (an excess to be avoided) to form barium dioxide octahydrate.



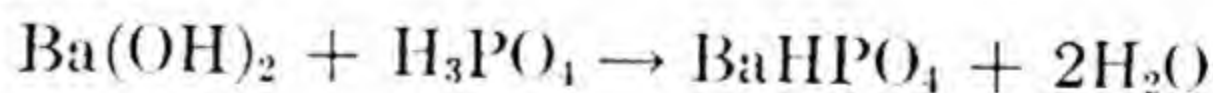
Em. Schöne, Ber., **6**, 1173 (1873)

11



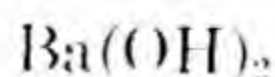
I-2366

Barium acid phosphate is formed when barium hydroxide is treated with phosphoric acid.



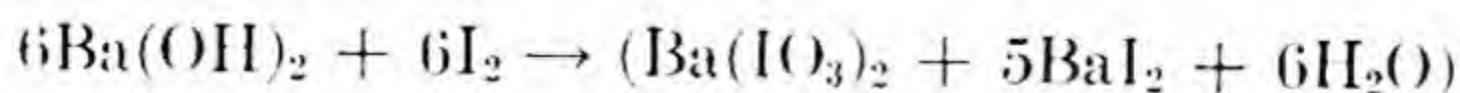
Tartar and Lorah, J. Am. Chem. Soc., **51**, 1092 (1929)

1



I-2367

Barium iodate and iodide are formed when barium hydroxide is boiled with an excess of iodine.

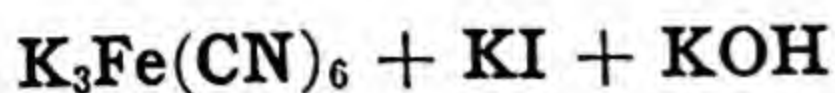
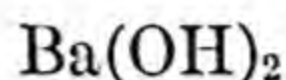


Phelps, J. Am. Chem. Soc., **2**, 67, (1880)

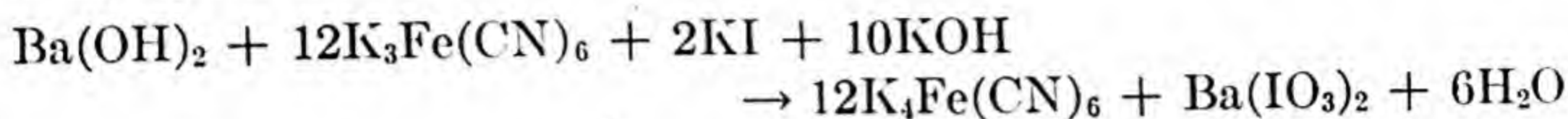
Ref., Walker and Gillespie, Am. J. Sci., **156**, 455 (1898)

Ref., J. Am. Chem. Soc., **23**, 38 (1901)

1

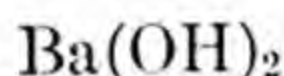
**I-2368**

Barium hydroxide reacts with potassium ferricyanide and iodide in strong potassium hydroxide solution.

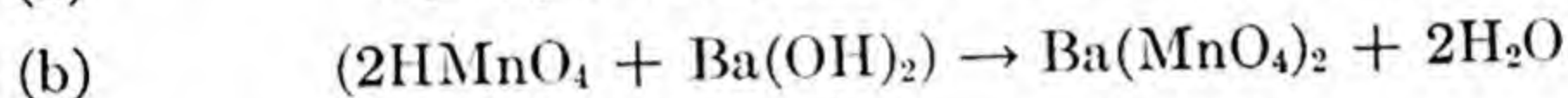
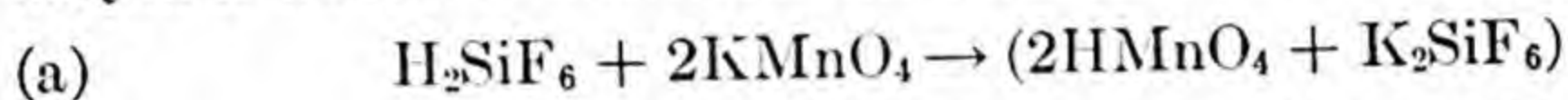


Kassner, Arch. Pharm., **236**, 165

25

**I-2369**

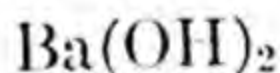
Barium permanganate is produced when a cold saturated solution of potassium permanganate is treated with fluosilicic acid at 30° Bé and allowed to stand for some time; then a sufficient quantity of milk of baryta is added to neutralize the fluosilicic acid originally used.



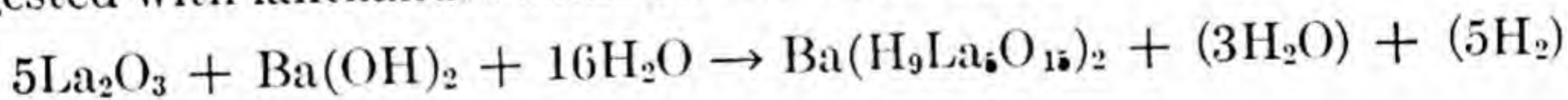
Rousseau and Bruneau: Bull. soc. chim., **41**, 246 (1884)

Ref., E. W. K., J. Am. Chem. Soc., **6**, 77 (1884)

1

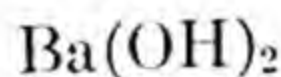
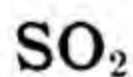
**I-2370**

Barium polymetalanthanate is formed when barium hydroxide is digested with lanthanum oxide on the water bath.

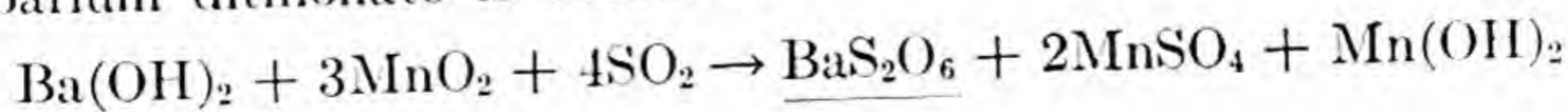


Baskerville and Catlett, J. Am. Chem. Soc., **26**, 78 (1904)

1

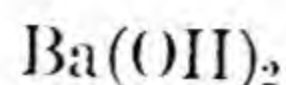
**I-2371**

By adding a barium hydroxide solution to a suspension of sulfur dioxide and manganese dioxide in water at a temperature of 0°C. a precipitate of barium dithionate is obtained.

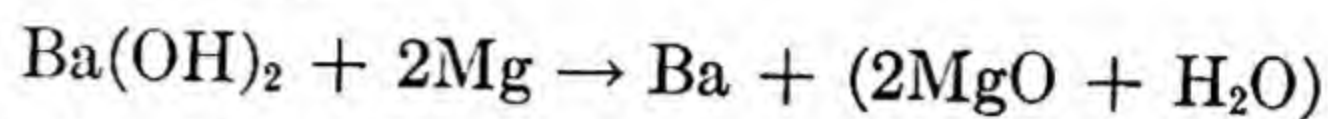


R. H. Ashley, Z. anorg. Chem., **51**, 116 (1906)

28

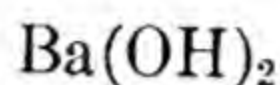
**Mg****I-2372**

Barium hydroxide is reduced to barium when heated with magnesium in a stream of hydrogen.

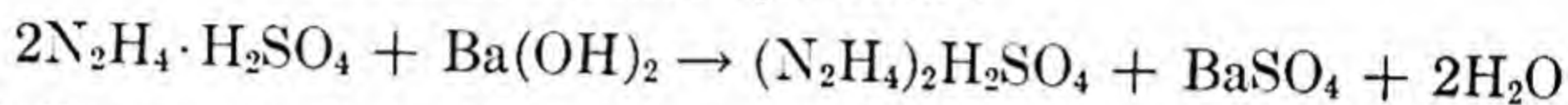


H. F. Keller, J. Am. Chem. Soc., **16**, 838 (1894)

1

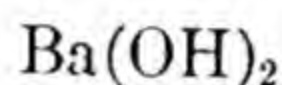
**N₂H₄·H₂SO₄****I-2373**

Hydrazine monosulfate is formed when hydrazine disulfate solution reacts with a solution of barium hydroxide.

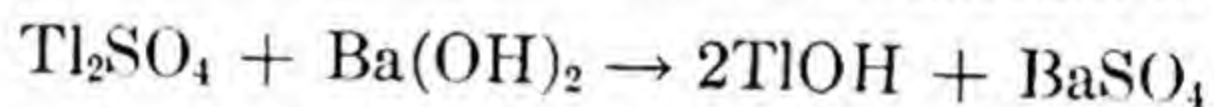


J. W. Turrentine, J. Am. Chem. Soc., **37**, 1112 (1915)

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**Tl₂SO₄****I-2374**

Thallous hydroxide in the forms of thin plates is made when thallous sulfate solution is treated with the calculated amount of baryta water.

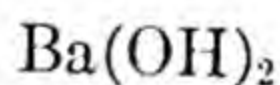


Lamy, Ann. Chim. Phys., [3], **67**, 392 (1863)

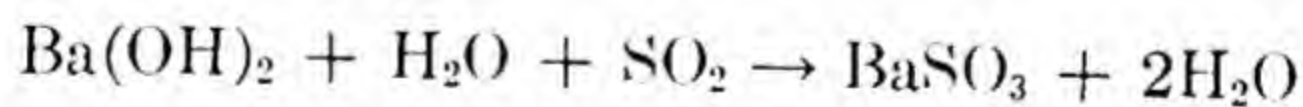
Ref., Dennis, Doan and Gill, J. Am. Chem. Soc., **18**, 977 (1896)

Ref., Phillips and Hartman, J. Am. Chem. Soc., **55**, 3065 (1933)

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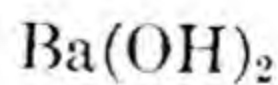
**SO₂****I-2375**

Barium sulfite can be prepared by passing sulfur dioxide into a solution of barium hydroxide.

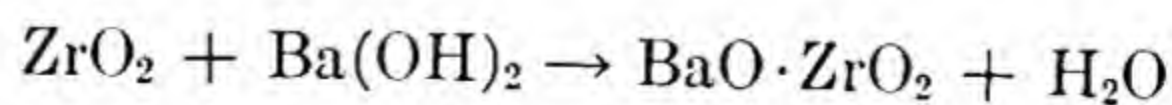


E. Divers and T. Haga, J. Chem. Soc. (London), **77**, 691 (1900)

102

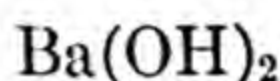
**ZrO₂****I-2376**

A zirconate of barium results when zirconium dioxide is fused with barium hydroxide.



Venable and Clarke, J. Am. Chem. Soc., **18**, 440 (1896)

1



I-2377

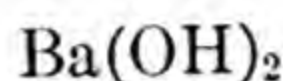
e

A solution of barium hydroxide was electrolyzed in order to prepare pure hydrogen and also pure oxygen.

- (a) $\text{Ba(OH)}_2 \rightarrow \text{Ba}^{++} + 2(\text{OH})^-$
 (b) $\text{Ba}^{++} + 2e \rightarrow \text{Ba}$
 (c) $\text{Ba} + 2\text{H}_2\text{O} \rightarrow \text{H}_2 + \text{Ba(OH)}_2$
 (d) $2(\text{OH})^- - 2e \rightarrow 2(\text{OH})$
 (e) $4(\text{OH}) \rightarrow 2\text{H}_2\text{O} + \text{O}_2$

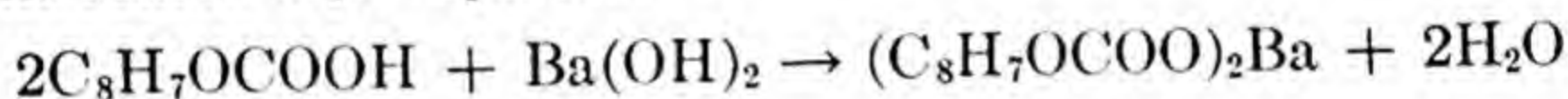
F. P. Burt and E. C. Edgar, *Trans. Roy. Soc. (London)*, **216A**, 394, 399 (1916)

105

**Acetylbenzoic acid**

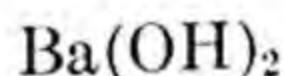
I-2378

Free acetylbenzoic acid is neutralized with barium hydroxide, the solution warmed, filtered and cooled. Crystals of barium acetylbenzoate with one-fourth H₂O separate.



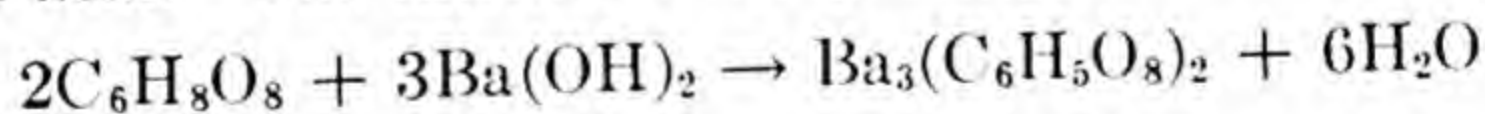
R. Meyer, *Ann.*, **219**, 263 (1883)

20

**Alpha-beta-dihydroxytricarballic acid**

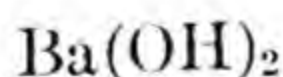
I-2379

A solution of alpha-beta-dihydroxytricarballic acid is neutralized with barium hydroxide, filtered and concentrated. Crystals of barium alpha-beta-dihydroxytricarballicate with five H₂O separate. The same type of reaction occurs when Ca(OH)₂ is treated with a solution of this acid. The calcium salt crystallizes with nine H₂O.



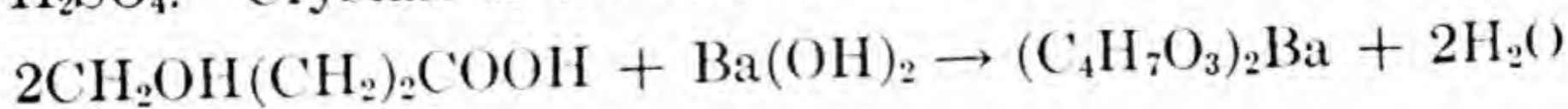
B. Pawolleck, *Ann.*, **178**, 160 (1875)

20

**Gamma-hydroxy-n-butyric acid**

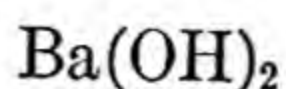
I-2380

An aqueous solution of gamma-hydroxy-n-butyric acid is treated with excess barium hydroxide, filtered and concentrated in a desiccator over H₂SO₄. Crystals of the barium salt with 2H₂O are formed.

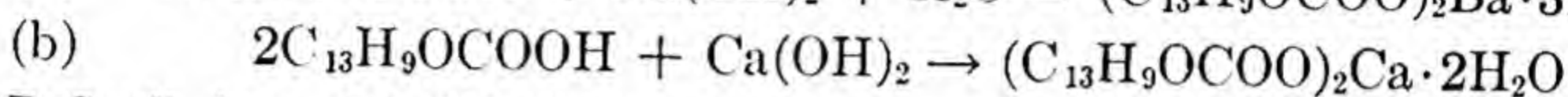
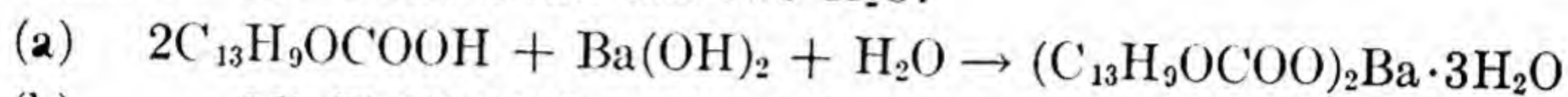


A. Saytzeff, *Ann.*, **171**, 270 (1874)

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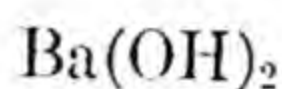
**m-Benzoylbenzoic acid****I-2381**

m-Benzoyl benzoic acid is dissolved in water and an aqueous solution of barium hydroxide added, the excess barium removed with a stream of carbon dioxide, the solution filtered and concentrated. Upon cooling crystals of barium m-benzoylbenzoate with three H₂O separate. A similar reaction occurs when this reagent is treated with calcium carbonate. The calcium salt has two H₂O.



P. Senff, *Ann.*, **220**, 240 (1883)

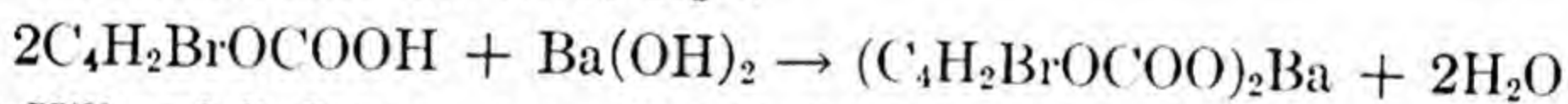
20

**3-Bromo-alpha-furoic acid****I-2382**

A hot aqueous solution of 3-bromo-alpha-furoic acid is saturated with barium hydroxide, filtered and concentrated over sulfuric acid. Crystals of barium 3-bromo-alpha-furoate separate, with one H₂O.

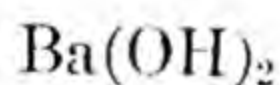
A similar reaction occurs when this reagent is treated with calcium carbonate, silver nitrate or potassium carbonate.

The calcium salt has three H₂O.

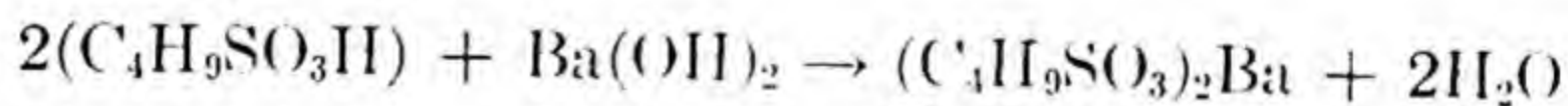


H. Hill and C. Sanger, *Ann.*, **232**, 59 (1886)

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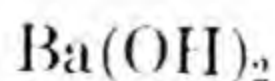
**n-Butanesulfonic acid****I-2383**

An aqueous solution of n-butane sulfonic acid is neutralized with barium hydroxide, filtered and concentrated on the water bath, then in a desiccator over H₂SO₄. Crystals of the barium salt of n-butane sulfonic acid separate with one H₂O.

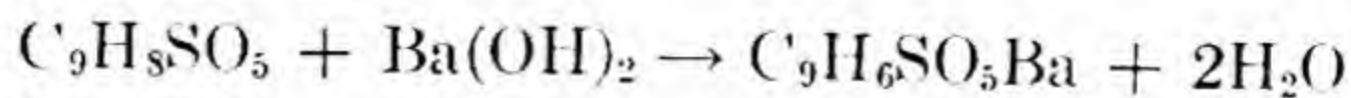


N. Grabowsky and A. Saytzeff, *Ann.*, **171**, 252 (1874)

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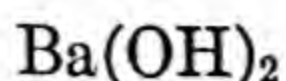
**Cinnamic-acid-4-sulfonic acid****I-2384**

An aqueous solution of cinnamic-acid-4-sulfonic acid is neutralized with barium hydroxide, filtered and concentrated. The barium salt crystallizes with one H₂O.



W. Rudnew, *Ann.*, **173**, 13 (1874)

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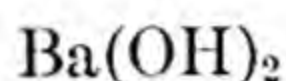
**Diethylmethyl acetic acid****I-2385**

A solution of barium hydroxide is added in excess to an aqueous solution of diethylmethylacetic acid and the excess barium removed by passing in CO_2 ; the solution is filtered, concentrated and cooled. Crystals of the hydrated barium salt separate.



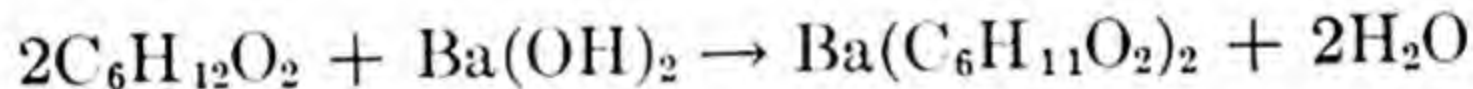
E. Schdanoff, *Ann.*, **185**, 122 (1877)

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**Dimethylethyl acetic acid****I-2386**

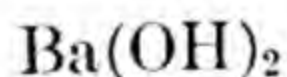
An aqueous solution of dimethylethylacetic acid is saturated with barium hydroxide, filtered and the excess barium precipitated with carbon dioxide. The filtered solution is concentrated and barium dimethylethylacetate crystallizes with five H_2O .

A similar reaction occurs when dimethylethylacetic acid is treated with Ca(OH)_2 .

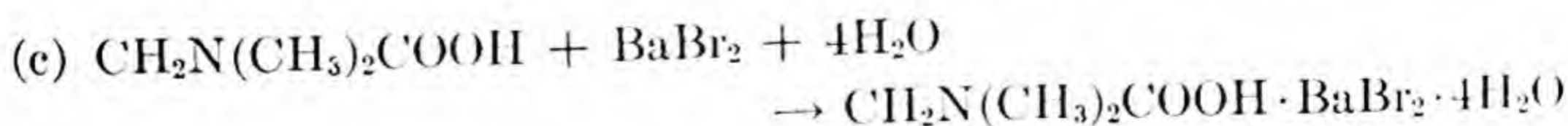
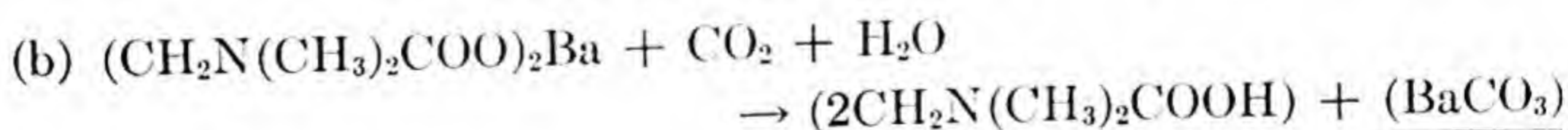
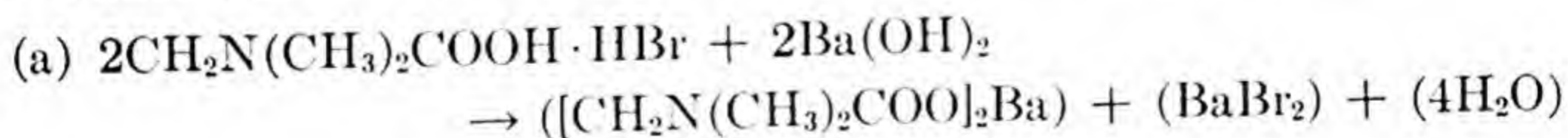


A. Wischnegradsky, *Ann.*, **174**, 58 (1874)

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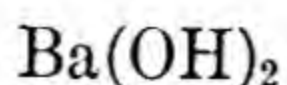
**N-dimethylaminoacetic acid hydrobromide****I-2387**

An aqueous solution of N-dimethylaminoacetic acid hydrobromide is boiled with excess barium hydroxide. The mixture is treated with carbon dioxide and filtered; when concentrated, the solution precipitates N-dimethylamino-acetic acid barium bromide tetrahydrate.

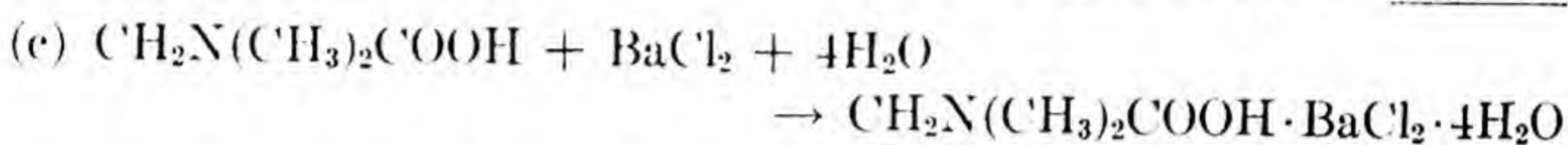
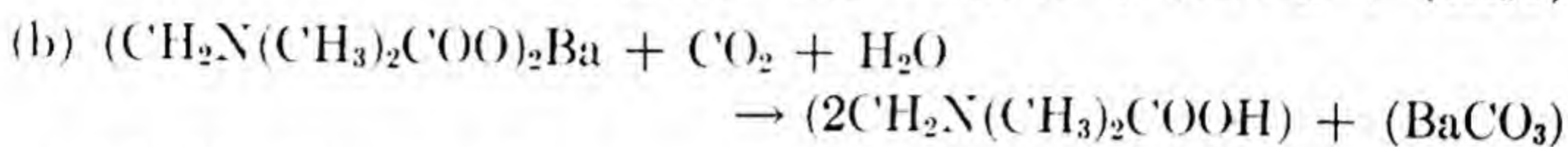
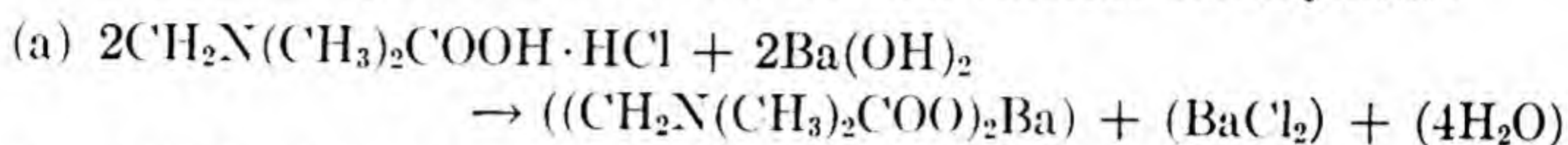


Anslow and King, *Biochem. J.*, **22**, 1259 (1928)

53

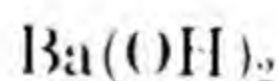
**N-dimethylaminoacetic acid hydrochloride****I-2388**

An aqueous solution of N-dimethylaminoacetic acid hydrochloride is boiled with excess barium hydroxide. The mixture is treated with carbon dioxide and filtered; when concentrated, the solution precipitates N-dimethylaminoacetic acid barium chloride tetrahydrate.

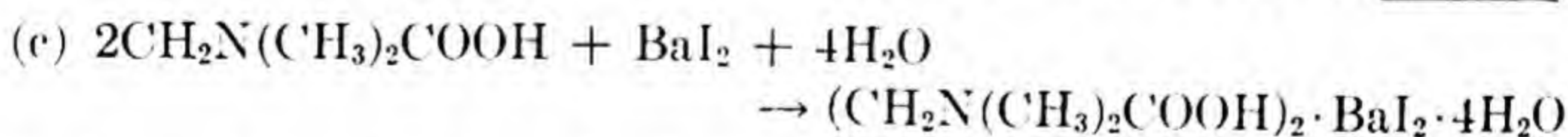
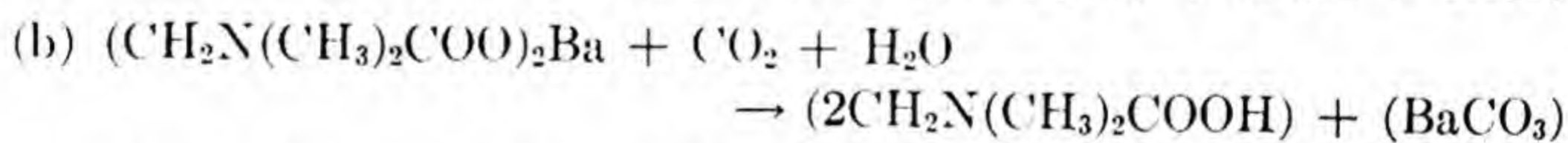
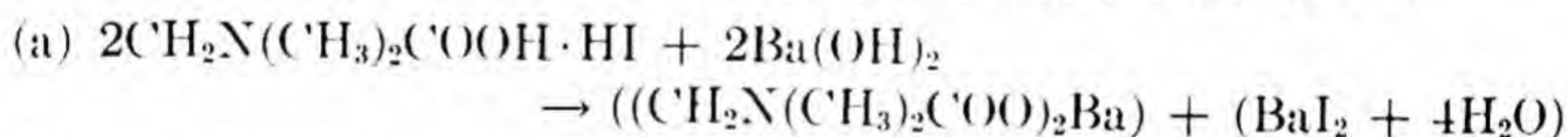


Anslow and King, *Biochem. J.*, **22**, 1259 (1928)

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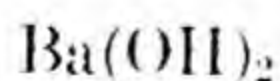
**N-dimethylaminoacetic acid hydroiodide****I-2389**

An aqueous solution of N-dimethylaminoacetic acid hydroiodide is boiled with excess barium hydroxide. The mixture is treated with carbon dioxide and filtered; when concentrated, the solution precipitates N-dimethylaminoacetic acid barium iodide tetrahydrate.

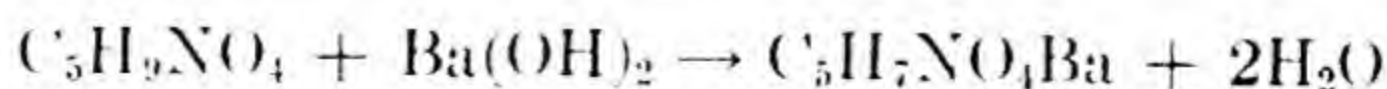


Anslow and King, *Biochem. J.*, **22**, 1259 (1928)

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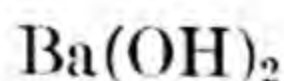
**Glutamic acid****I-2390**

A solution of glutamic acid is neutralized with barium hydroxide, the solution concentrated in vacuo over H_2SO_4 . Dibasic barium glutamate crystallizes. The same type of reaction occurs when a solution of glutamic acid is neutralized with NH_4OH .

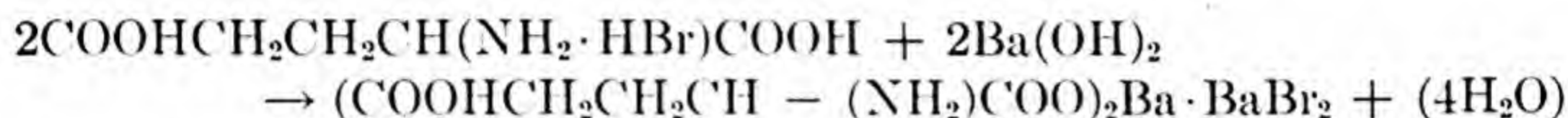


J. Habermann, *Ann.*, **179**, 250-1 (1875)

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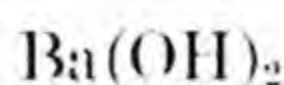
**Glutamic acid hydrobromide****I-2391**

Glutamic acid hydrobromide is dissolved in water, the solution is made alkaline with barium hydroxide, and then is saturated with carbon dioxide. The solution, after filtration, deposits a double salt of barium glutamate and barium bromide.

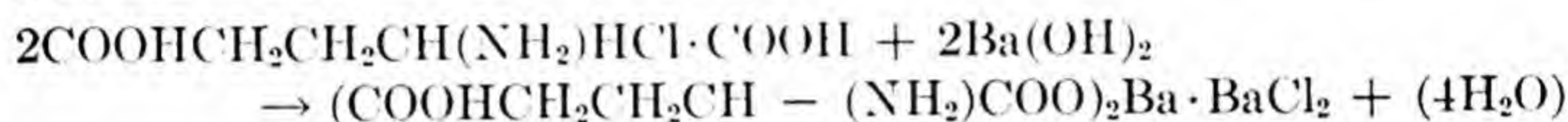


Anslow and King, *Biochem. J.*, **21**, 1175 (1927)

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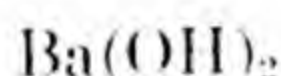
**Glutamic acid hydrochloride****I-2392**

Glutamic acid hydrochloride is dissolved in water, the solution is made alkaline with barium hydroxide, and then is saturated with carbon dioxide. The solution, after filtration, deposits a double salt of barium glutamate and barium chloride.

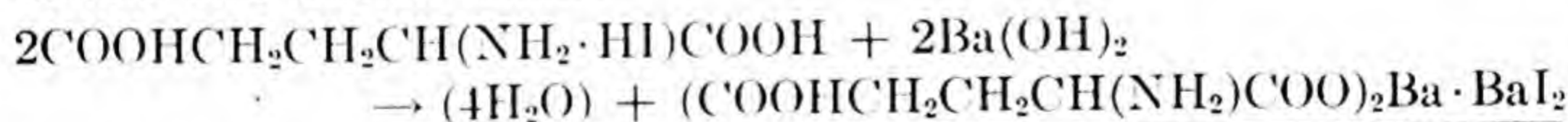


Anslow and King, *Biochem. J.*, **21**, 1175 (1927)

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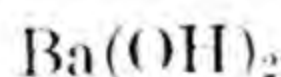
**Glutamic acid hydroiodide****I-2393**

Glutamic acid hydroiodide is dissolved in water, the solution is made alkaline with barium hydroxide, and then is saturated with carbon dioxide. The solution, after filtration, deposits a double salt of barium glutamate and barium iodide.

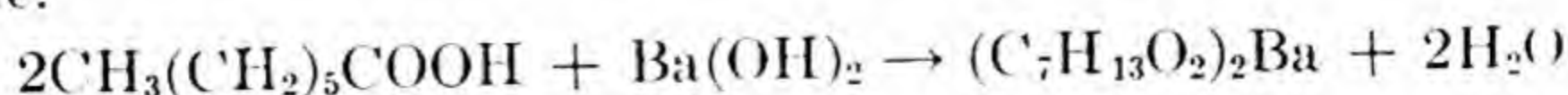


Anslow and King, *Biochem. J.*, **21**, 1176 (1927)

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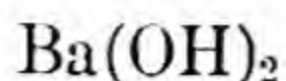
**Heptanoic acid****I-2394**

An excess of a solution of barium hydroxide is added to heptanoic acid and the excess barium removed by passing in CO_2 , the solution filtered and concentrated. Upon cooling, crystals of barium heptanoate precipitate.

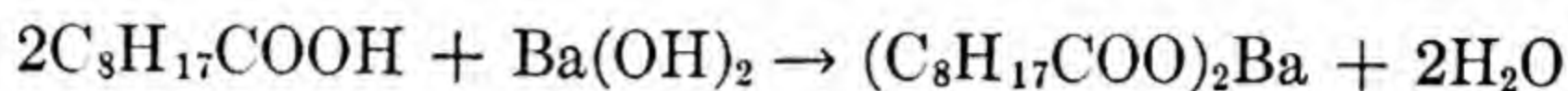


Th. Mehilis, *Ann.*, **185**, 364 (1877)

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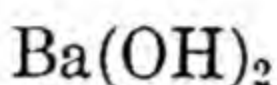
**Heptylacetic acid****I-2395**

Heptylacetic acid is warmed and neutralized with barium hydroxide. The excess barium is removed by passing a stream of carbon dioxide through the solution until no more precipitate forms. The solution is filtered and cooled. Crystals of barium heptylacetate separate.

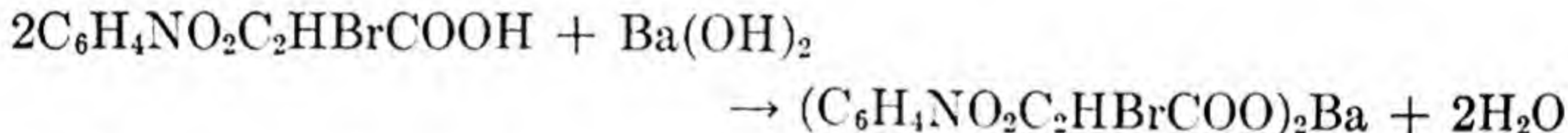


F. Jourdan, *Ann.*, **200**, 110 (1880)

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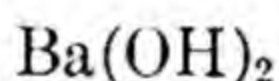
**p-Nitro-monobromo-cinnamic acid****I-2396**

p-Nitro-monobromo-cinnamic acid is dissolved in a solution of barium hydroxide and the excess barium removed by passing carbon dioxide through the solution. The solution is filtered and the filtrate concentrated over sulfuric acid. Crystals of barium-p-nitro-monobromo-cinnamate separate.

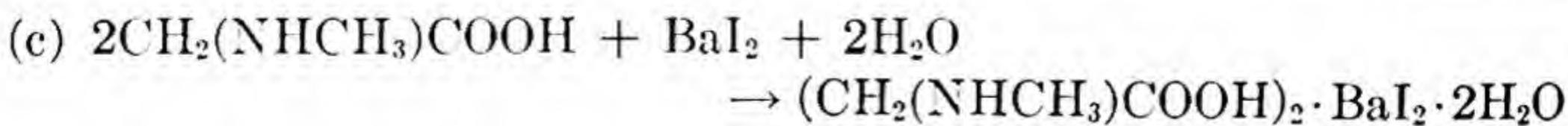
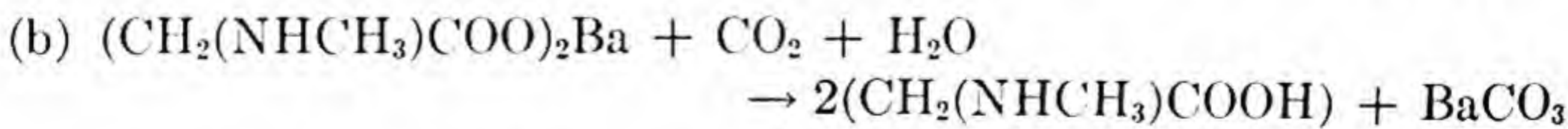
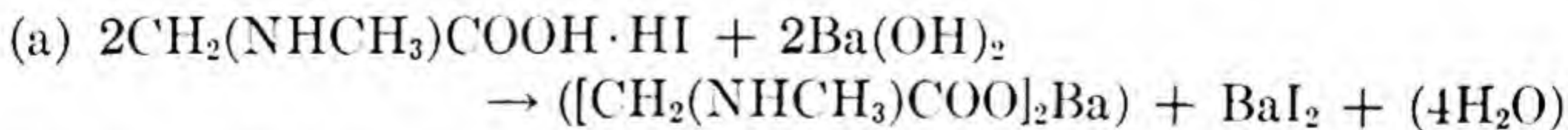


C. Muller, *Ann.*, **212**, 136 (1882)

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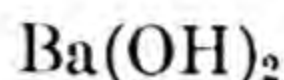
**Sarcosine hydroiodide****I-2397**

An aqueous solution of sarcosine hydroiodide is boiled with excess barium hydroxide. The mixture is treated with carbon dioxide and filtered; when concentrated, the solution precipitates disarcosine barium iodide dihydrate.



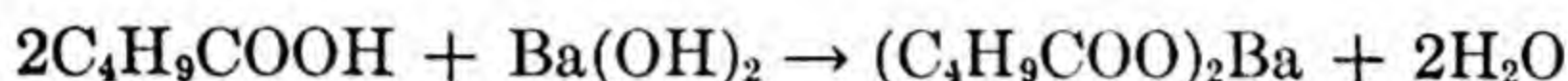
Anslow and King, *Biochem. J.*, **22**, 1256 (1928)

53

**n-Valeric acid****I-2398**

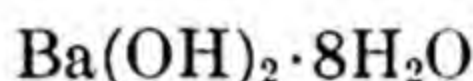
n-Valeric acid is saturated with a solution of barium hydroxide and the excess barium removed by passing in carbon dioxide. The solution is filtered and concentrated until crystals begin to form. Crystals of barium n-valerate are formed.

A similar reaction occurs when this reagent is treated in a similar manner with calcium hydroxide. The calcium salt crystallizes with one H_2O .

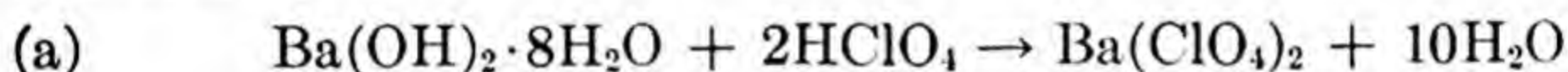


A. Kehler and B. Tollens, *Ann.*, **206**, 241-2 (1881)

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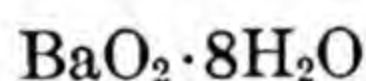
**I-2399**

Hydrazine diperchlorate is formed when barium perchlorate, produced by interaction of barium hydroxide and perchloric acid, is treated with hydrazine sulfate.

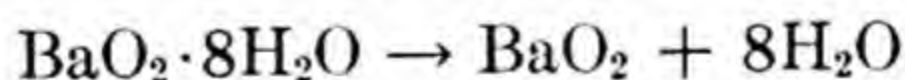


J. W. Turrentine, *J. Am. Chem. Soc.*, **37**, 1109 (1915)

1

 Δ **I-2400**

Barium dioxide octahydrate when heated slowly to temperatures not above 130°C . loses the water of hydration, forming a white powder.

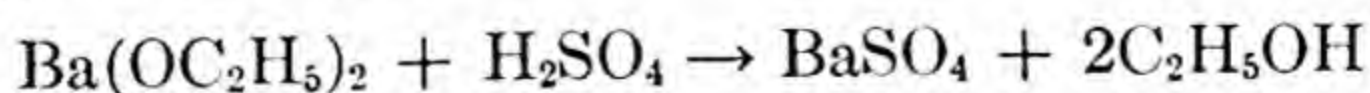


Em. Schöne, *Ber.*, **6**, 1174 (1873)

11

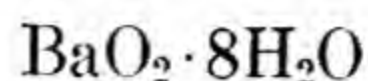
**I-2401**

If a solution of sulfuric acid (or soluble metal sulfate) in glycerine is carefully neutralized with barium ethylate, a stable colloidal solution of barium sulfate is obtained.



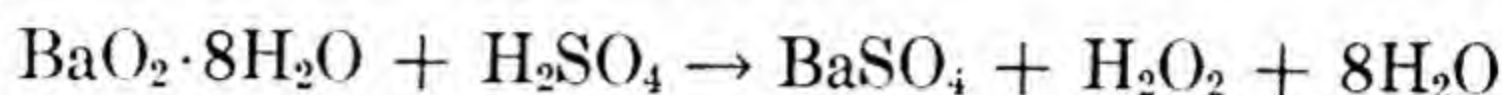
A. Recoura, *Compt. rend.*, **146**, 1274 (1908)

38


 H_2SO_4

I-2402

Barium peroxide octahydrate reacts with dilute sulfuric acid to form hydrogen peroxide and barium sulfate.



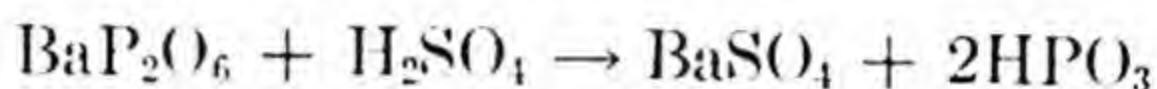
Julius Thomsen, *Ber.*, **7**, 74 (1874)

11


 H_2SO_4

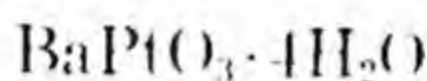
I-2403

Barium metaphosphate in the form of a fine powder is treated with sulfuric acid ($d = 1.165$) for 10 days. The filtrate from the barium sulfate precipitate contains metaphosphoric acid.



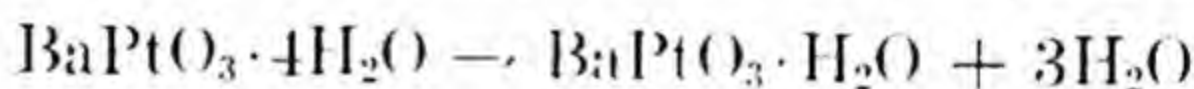
F. Warschauer, *Z. anorg. Chem.*, **36**, 137 (1903)

28

 Δ

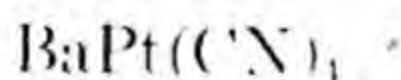
I-2404

On heating barium platinate tetrahydrate to 300°C ., three molecules of water are lost, forming barium platinate monohydrate.



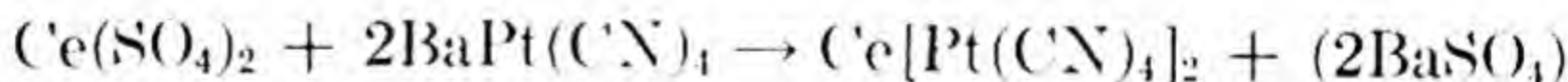
H. Topsöe, *Ber.*, **3**, 465 (1870)

11


 $\text{Ce}(\text{SO}_4)_2$

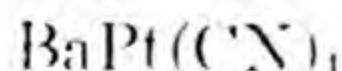
I-2405

When the calculated quantities of barium platinocyanide and ceric sulfate are mixed together in aqueous solution, ceric platinocyanide crystallizes out.



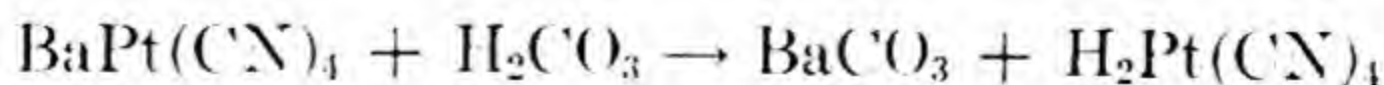
L. A. Levy, *J. Chem. Soc.*, (London), **93**, 1456 (1908)

57


 H_2CO_3

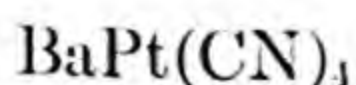
I-2406

Platinocyanic acid may be prepared by passing carbon dioxide through a solution of barium platinocyanide.



R. J. Friswell and A. J. Greenaway, *J. Chem. Soc.* (London), **32**, 252 (1877)

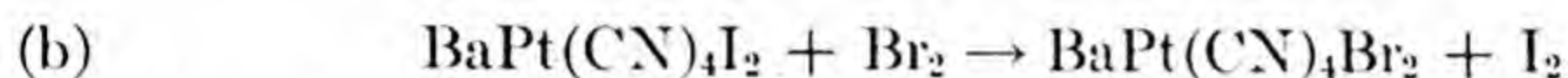
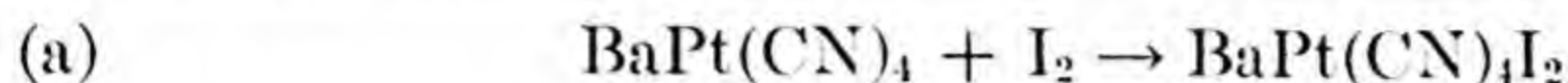
13

I₂

I-2407

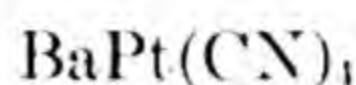
Br₂

When a solution of pure barium platinocyanide is treated with iodine solution, barium periodoplatinocyanide is produced. This compound, boiled with excess bromine, forms the perbromoplatinocyanide.



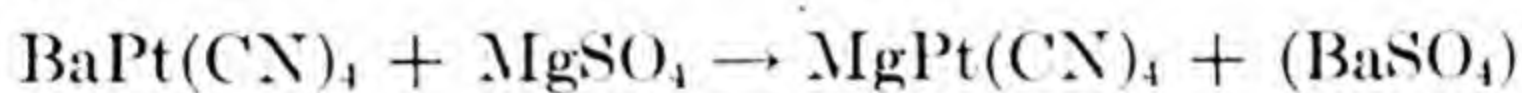
L. A. Levy, J. Chem. Soc. (London), **101**, 1081 (1912)

57

MgSO₄

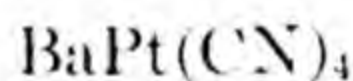
I-2408

Magnesium sulfate and barium platinocyanide react to form magnesium platinocyanide.



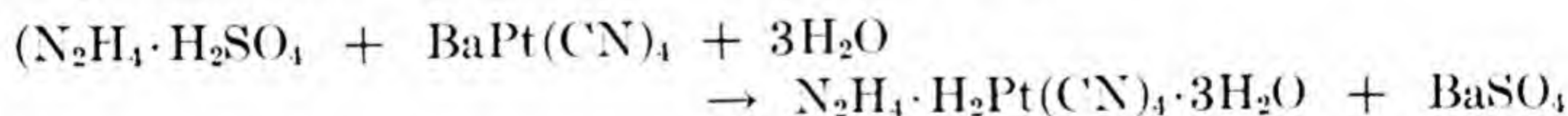
L. A. Levy, J. Chem. Soc. (London), **93**, 1456 (1908)

57

N₂H₄·H₂SO₄

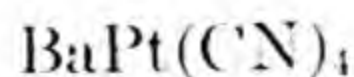
I-2409

Equivalent quantities of hydrazine sulfate and barium platinocyanide when mixed yield hydrazine platinocyanide. Red crystals, containing water are formed upon spontaneous evaporation of the solution. The crystals lose water at 28°, becoming white. A similar reaction occurs when hydroxylamine sulfate is used as reagent. These crystals are very soluble and contain two molecules of water.



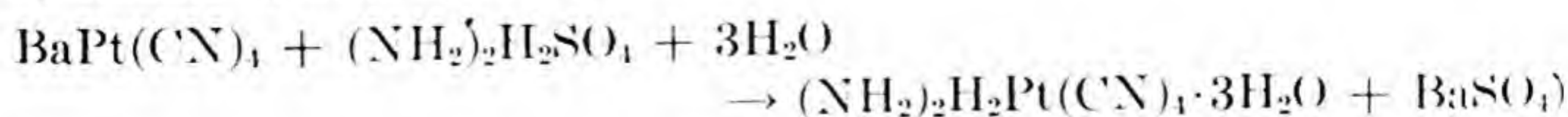
Levy and Sisson, J. Chem. Soc. (London), **89**, 125 (1906)

109

(NH₂)₂H₂SO₄

I-2410

Solutions of hydrazine sulfate and barium platinocyanide react to form hydrazine platinocyanide.



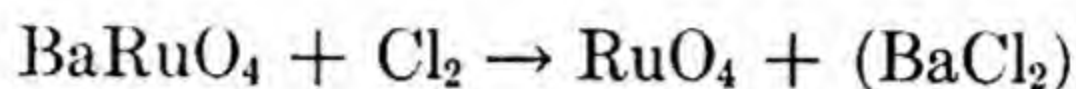
Levy and Sisson, J. Chem. Soc. (London), **89**, 125 (1906)

103

BaRuO₄Cl₂

I-2411

When barium ruthenate is treated with chlorine ruthenium tetroxide is obtained.



H. Sainte-Claire-Deville and H. Debray,
Ref., A. Henninger, Ber., **8**, 339 (1875)

26

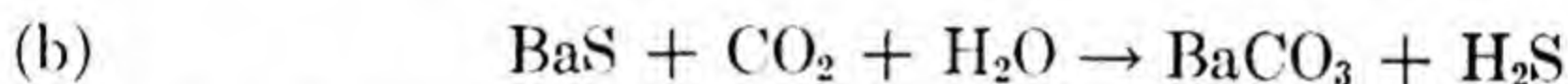
BaS

C

I-2412

CO₂

Barium carbonate may be obtained easily through reduction of barium sulfate with carbon and treating of the sulfide with carbon dioxide:



V. Gerber, Z. Elektrochem. **25**, 205 (1919)

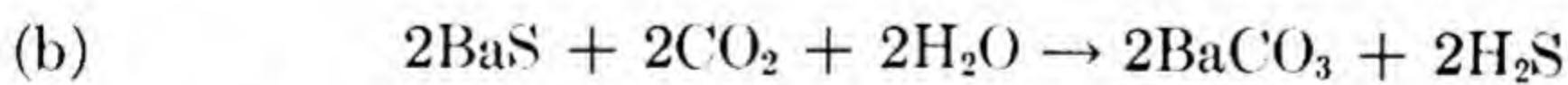
86

BaS

CO₂ + H₂O

I-2413

Carbon dioxide is passed into a solution of barium sulfide.



Riviere, Bull. Soc. Mülh., **36**, 438 (1866)

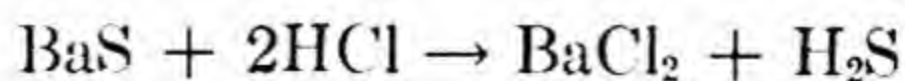
25

BaS

HCl

I-2414

Barium sulfide reacts with hydrochloric acid.



H. Toussaint, l'Ind. Chim., **5**, 250 (1918)

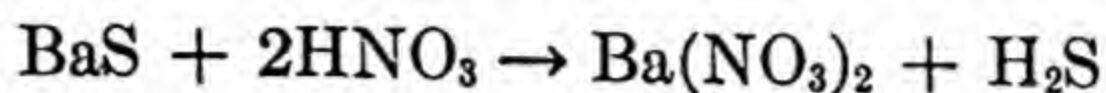
25

BaS

HNO₃

I-2415

Barium sulfide reacts with nitric acid.



W. O. Snelling, U. S. Pat. 1,285,824, Nov. 26 (1918)

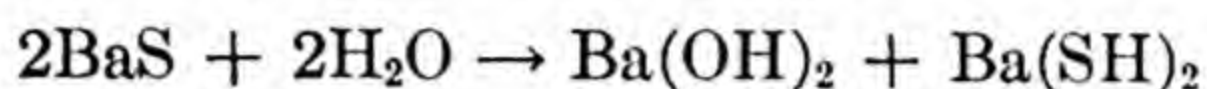
25

BaS

H₂O

I-2416

The hydrolysis of barium sulfide is investigated:



E. Terres and K. Brückner, Z. Elektrochem., **26**, 5 (1920)

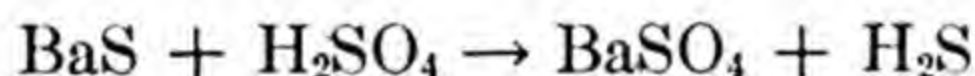
86

BaS

H₂SO₄

I-2417

Barium sulfide may be transformed to barium sulfate by reacting it with sulfuric acid.



M. Bussy and Buigne, Chem. News, **9**, 74 (1864)

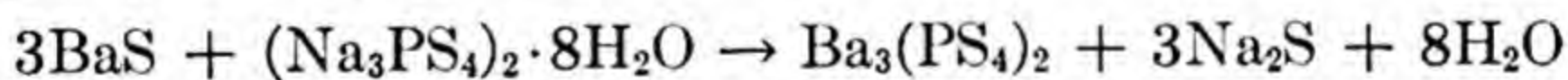
101

BaS

Na₃PS₄·8H₂O

I-2418

Freshly precipitated barium sulfide reacts with hydrated sodium thio ortho-phosphate by gentle warming.



Ephraim and Rebecca Stein, Ber, **44**, 3409 (1911)

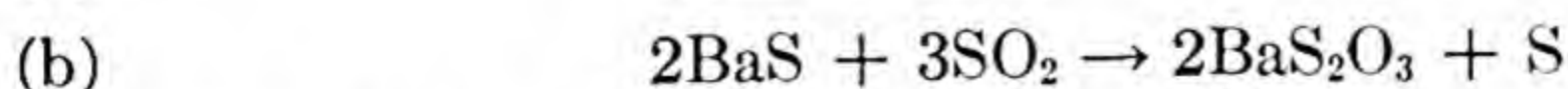
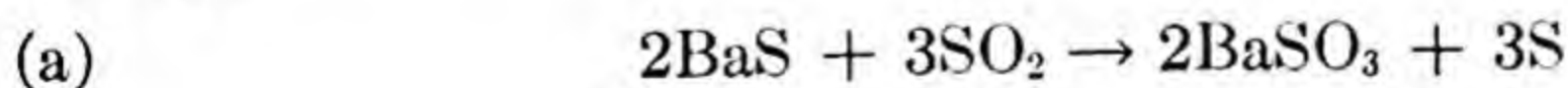
25

BaS

SO₂

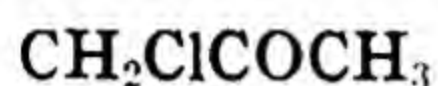
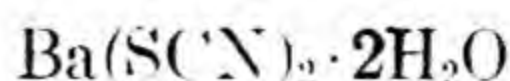
I-2419

If a solution of barium sulfide or a finely divided suspension is added to a solution of sulfur dioxide, barium sulfite and barium thiosulfate are formed.



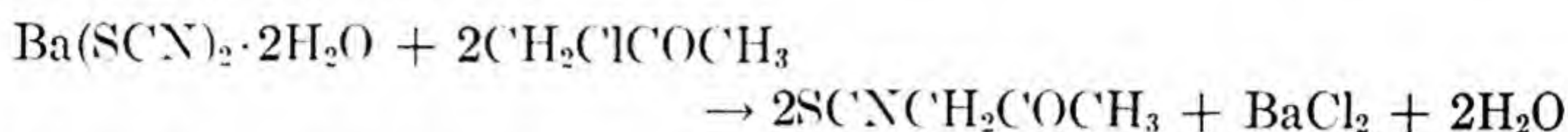
A. E. Wells, J. Ind. Eng. Chem., **9**, 872 (1917)

22



I-2420

The action of barium thiocyanate on monochloro-acetone in alcoholic solution results in the formation of thiocyano-acetone. The reaction also takes place in absence of alcohol when the barium salt is intimately mixed with monochloroacetone.



Hellon and Tscherniac, Ber., **16**, 349 (1883)

Ref., Tscherniac, Ber., **25**, 2623 (1892)

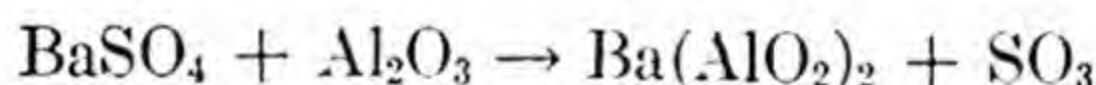
Ref., Tscherniac, J. Chem. Soc. (London), **115**, 1071 (1919)

48



I-2421

Reaction between barium sulfate and alumina is appreciable above 1000°C, and complete above 1238°C. The mono-barium aluminate formed is water-soluble and sulfur-free.

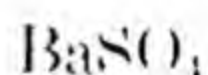


H. S. Booth and R. Ward, J. Phys. Chem., **36**, 984 (1932)

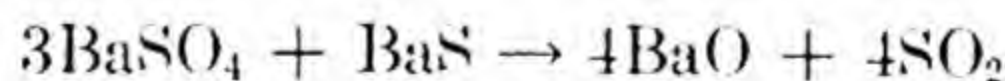
85

Ref., P. R. Hershman, U. S. Pat., 1,240,572, Sept. 18 (1917)

25

●
I-2422

When barium sulfate and barium sulfide are heated with coal in an electric furnace, barium oxide is produced.



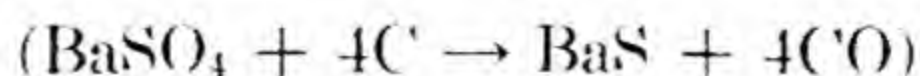
T. H. Norton, J. Ind. Eng. Chem., **5**, 704 (1913)

22



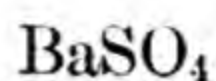
I-2423

When barium sulfate in a filter paper is ignited, appreciable amounts, even as high as 10% of the sulfate may be reduced to the sulfide.



S. F. Acree, J. Biol. Chem., **1**, 136 (1905)

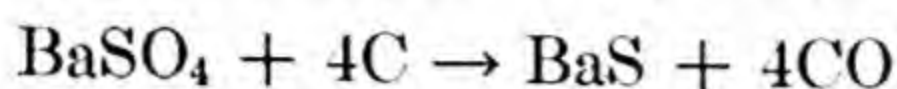
88



C

I-2424

Barium sulfate is heated with carbon in an electric furnace at 1000°.



A. E. Wells, *J. Ind. and Eng. Chem.*, **8**, 1770 (1916)

25



C

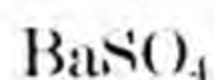
I-2425

When barium sulfate is heated with coal at temperatures between 600 and 800°C, barium sulfide is produced. At higher temperatures (equation b) carbon monoxide is produced.



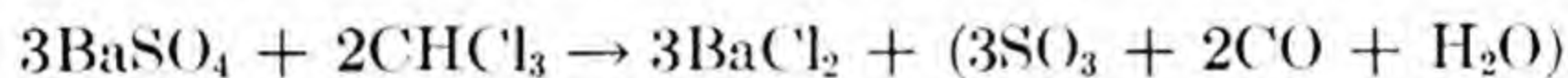
T. H. Norton, *J. Ind. Eng. Chem.*, **5**, 704 (1913)

22

CHCl₃

I-2426

Anhydrous barium chloride is produced when anhydrous barium sulfate is heated in a current of dry carbon dioxide and chloroform at 500°.



Conduche, *Compt. rend.* **158**, 1180

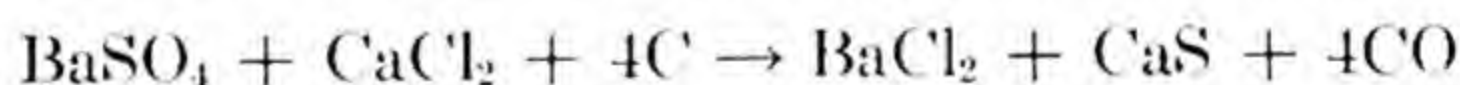
Ref., J. L. Howe, *J. Am. Chem. Soc.*, **37**, 548 (1915)

1

CaCl₂ + C

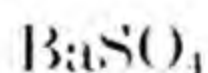
I-2427

Barium sulfate is fused with a mixture of calcium chloride and carbon.



D'Heureuse, *Pogg. Ann.*, **75**, 276 (1848)

25



Fe

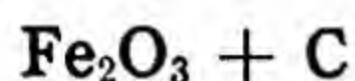
I-2428

Barium sulfate is fused with iron.



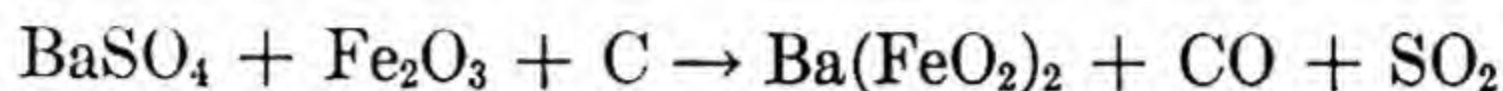
D'Heureuse, *Pogg. Ann.*, **75**, 273 (1848)

25



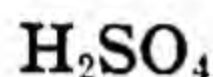
I-2429

Barium sulfate heated to 950° with iron oxide and carbon yields barium ferrite.



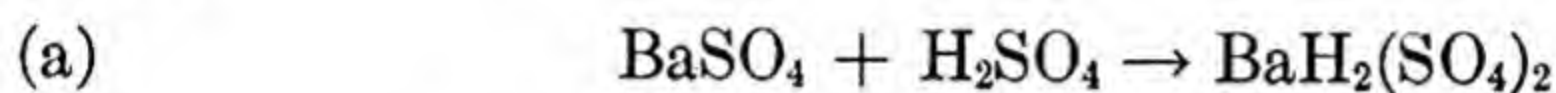
Martin and Fuchs, *Z. Anorg. Chem.*, **125**, 307 (1923)

25



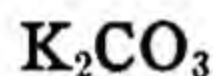
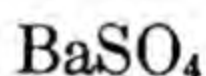
I-2430

Barium sulfate is dissolved in conc. H₂SO₄ and the yellow solution cooled.



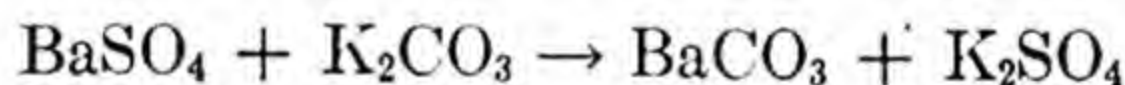
P. Rohland, *Z. Anorg. Chem.*, **66**, 206 (1910)

25



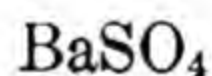
I-2431

Barium sulfate dissolves slightly in a solution of potassium carbonate.



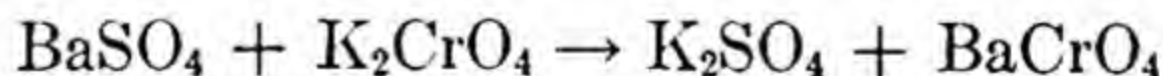
Rose, *Pogg. Ann.*, **94**, 482 (1855)

25



I-2432

The equilibrium of the reaction given below is studied.



M. Scholtz and R. Abegg, *Z. Elektrochem.*, **12**, 425 (1906)

86



I-2433

Barium sulfate reacts with sulfur trioxide to form barium pyrosulfate.



C. Schultz-Sellack, *Ber.*, **4**, 111 (1871)

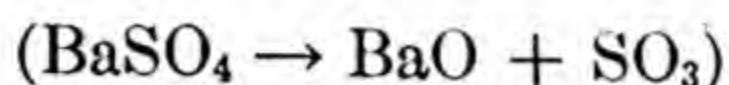
11



Δ

I-2434

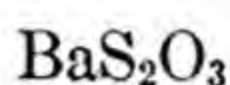
Barium and strontium sulfates are decomposed by heat only above the melting point of iron, about 1510°C.



H. Mostowitsch, *Metallurgie*, **8**, 763 (1911)

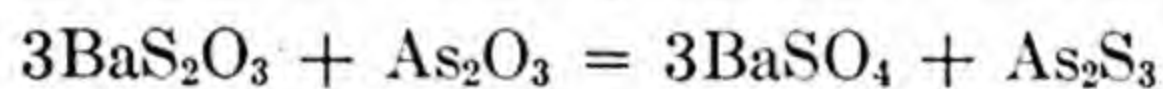
Ref.: G. Marchal, *J. Chim. phys.*, **22**, 325 (1925)

69

As₂O₃

I-2435

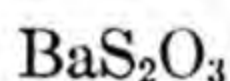
Arsenic trioxide reacts with a boiling solution of barium thiosulfate.



W. Thorn, *Dingler's Polytech. J.*, **217**, 495

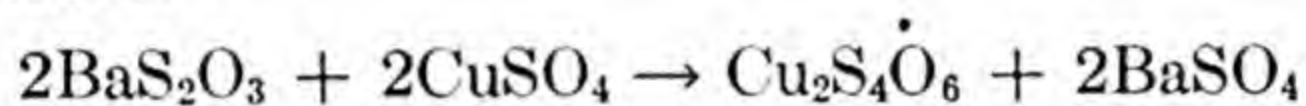
Ref., M. M. P. M., *J. Chem. Soc. (London)*, **29**, 517 (1876)

25

CuSO₄

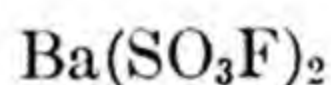
I-2436

Barium thiosulfate reacts with copper sulfate to give a solution of cuprous tetrathionate.



G. Chancel and E. Diacon, *Compt. Rend.*, **56**, 711 (1863)

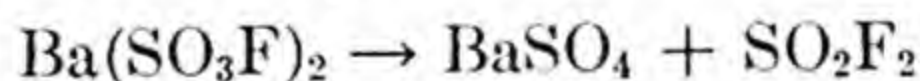
29



Δ

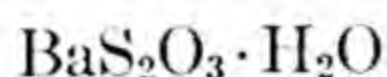
I-2437

Barium fluosulfonate is decomposed by heating.



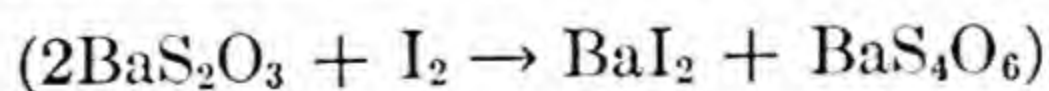
Troube, Hoerenz and Wendelick, *Ber.* **52**, 1272 (1919)

25

I₂

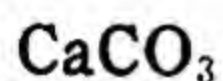
I-2438

The reaction of barium thiosulfate with iodine in solution serves as an excellent method for standardizing an iodine solution.



Plimpton and Chorley, *J. Chem. Soc. (London)*, **67**, 314 (1895)

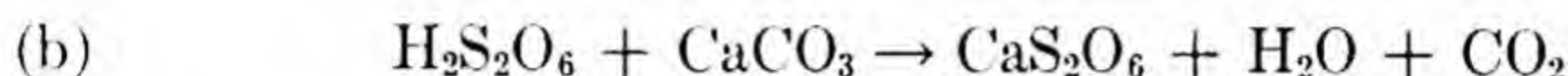
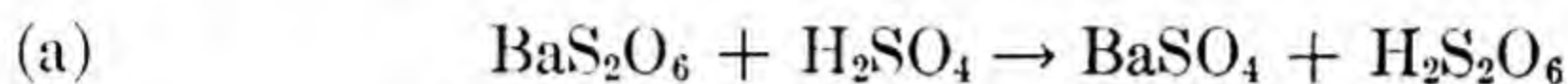
103



I-2439



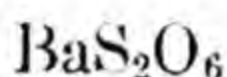
Calcium strontium and lead dithionates are prepared by treating their carbonates with dithionic acid. Dithionic acid is prepared by adding sulfuric acid to barium dithionate.



Rose, Neu. Jahrb. Min. Geol., **29**, 89 (1910)

Ref.: Barnes and Helwig, Can. J. Research, **4**, 567 (1931)

94



I-2440

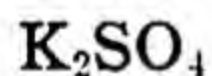
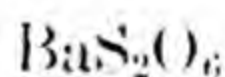
If solutions of potassium sulfate and barium dithionate are mixed and warmed, barium sulfate is precipitated and the dithionate obtained by evaporation of the solution.



Rose, Neu. Jahrb. Min. Geol., **29**, 89 (1910)

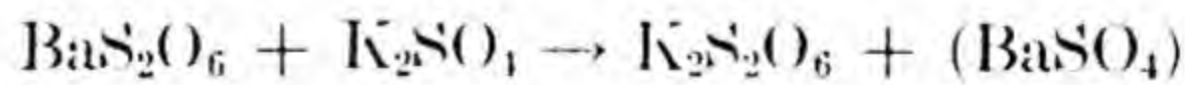
Ref.: Barnes and Helwig, Can. J. Research, **4**, 567 (1931)

94



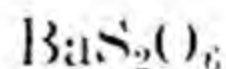
I-2441

- Potassium dithionate or the acid is formed when a solution of barium dithionate is treated with potassium sulfate or dilute sulfuric acid.



Yost and Pomeroy, J. Am. Chem. Soc., **49**, 704 (1927)

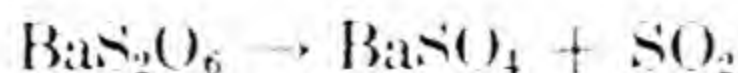
1



Δ

I-2442

Barium dithionate decomposes when heated in a sealed tube to 150–180°.



Cornog and Henderson, J. Am. Chem. Soc., **46**, 1978 (1924)

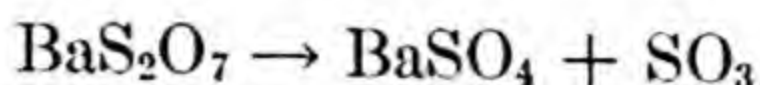
25



Δ

I-2443

Barium pyrosulfate in the presence of fuming sulfuric acid breaks down into barium sulfate and sulfur trioxide.



C. Schultz-Sellack,

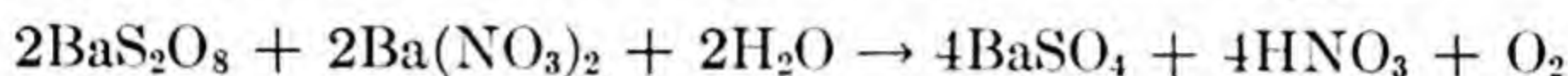
Ref., Gazz. chim. ital., **1**, 101 (1871)

21

Ba(NO₃)₂

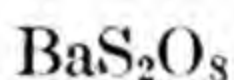
I-2444

If barium persulfate is reacted with barium nitrate and water the products yielded are barium sulfate, nitric acid and oxygen.



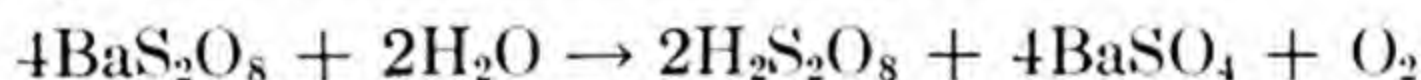
Green and Masson, J. Chem. Soc. (London), **97**, 2093 (1910)

103

H₂O

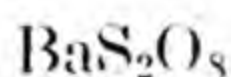
I-2445

If barium persulfate is treated with water the products formed are barium sulfate, persulfuric acid and oxygen.



Green and Masson, J. Chem. Soc. (London), **97**, 2089 (1910)

103

H₂SO₄

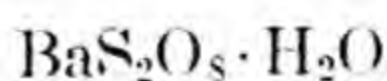
I-2446

Persulfuric acid is prepared by adding sulfuric acid to barium persulfate.



J. Green and O. Masson, J. Chem. Soc. (London), **97**, 2086 (1910)

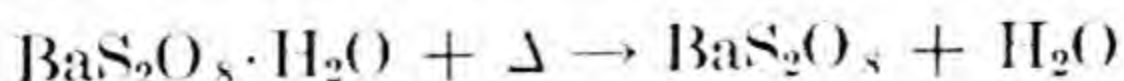
57



Δ

I-2447

The tetrahydrated barium sulfate (BaS₂O₈·4H₂O) is prepared by treating a saturated solution of ammonium persulfate with Ba(OH)₂ and evaporating "in vacuum." However, if the saturated solution is treated with an excess of alcohol and evaporated the monohydrate is obtained; which loses its water of hydration upon gentle warming.



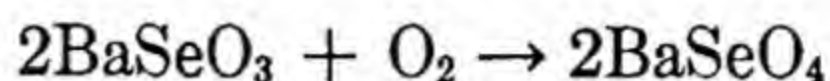
H. Marshall, J. Chem. Soc. (London), **59**, 779 (1891)

25

O₂

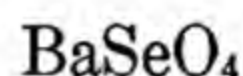
I-2448

Barium selenite is oxidized at 700–750° to selenate.



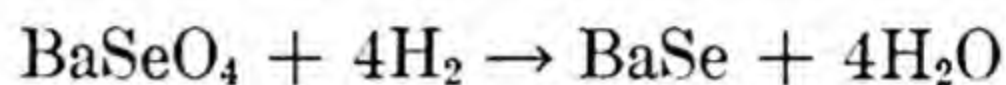
Lenher and Wechter, *J. Am. Chem. Soc.*, **47**, 1523 (1925)

1

H₂

I-2449

Barium selenate is reduced by hydrogen at 500°.



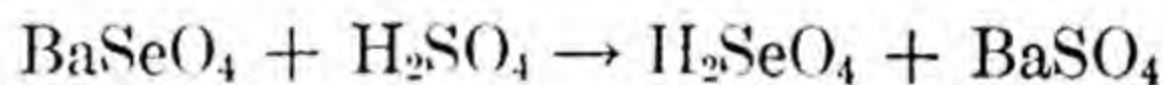
Henglein and Roth, *Z. anorg. Chem.*, **126**, 227 (1923)

25

H₂SO₄

I-2450

Selenic acid is formed when barium selenate is suspended in water and treated with dilute sulfuric acid.



Lenher and Wechter, *J. Am. Chem. Soc.*, **47**, 1523 (1925)

1

(NH₄)₂CO₃

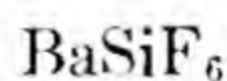
I-2451

Barium carbonate precipitates and ammonium selenate crystallizes from solution when barium selenate is treated with ammonium carbonate.



Mathers and Bonsib, *J. Am. Chem. Soc.*, **33**, 705 (1911)

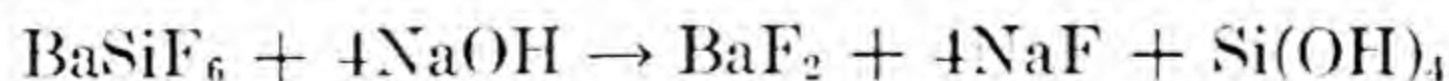
1



NaOH

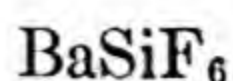
I-2452

Barium fluosilicate is converted, by dilute sodium hydroxide, into silicon hydroxide, barium fluoride, and sodium fluoride.



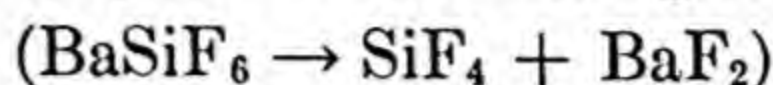
Carter, *Ind. Eng. Chem., Anal. Ed.*, **3**, 146 (1931)

114

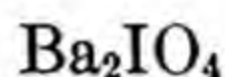


Δ I-2453

Barium fluosilicate decomposes at red heat giving silicon tetrafluoride.

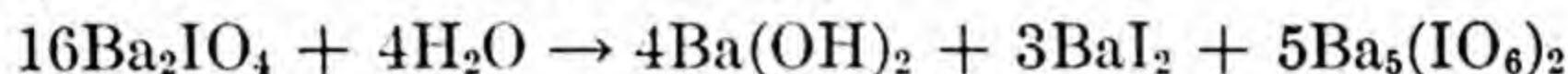


A. Jaquerod and M. Tourpaian, *J. Chim. phys.*, **11**, 3 (1913) 69

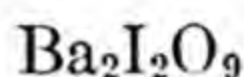


H₂O I-2454

Barium periodate is treated with water.

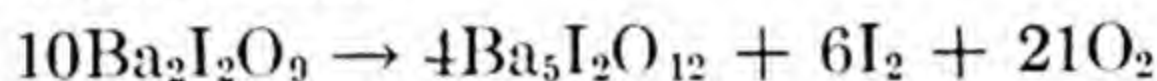


C. F. Rammelsberg, *Pogg. Ann.*, **137**, 315 (1869) 25

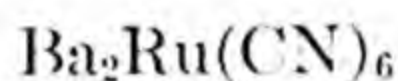


Δ I-2455

Barium dimesoperiodate decomposes at red heat forming barium para periodate, oxygen and iodine.

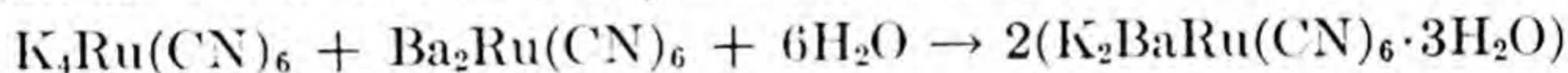


C. Rammelsburg, *Ber.*, **1**, 132 (1868) 11



K₄Ru(CN)₆ I-2456

Barium potassium rutheno-cyanide is prepared by mixing equivalent solutions of the barium and potassium salts.

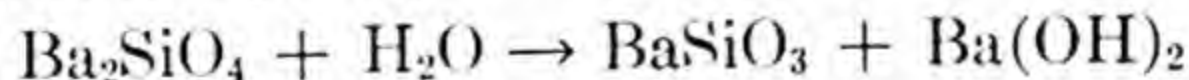


Howe and Campbell, *J. Am. Chem. Soc.*, **20**, 30 (1898) 1

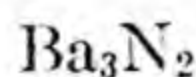


H₂O I-2457

Barium orthosilicate hydrolyzes.

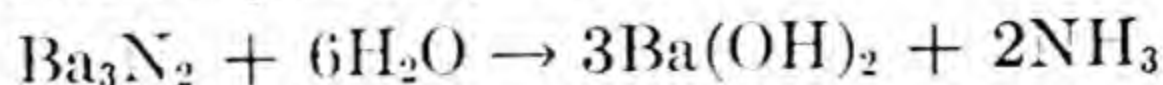


C. Deguide, *Brit. Pat.* 110,537 (1917) 25

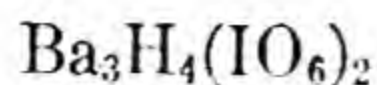


H₂O I-2458

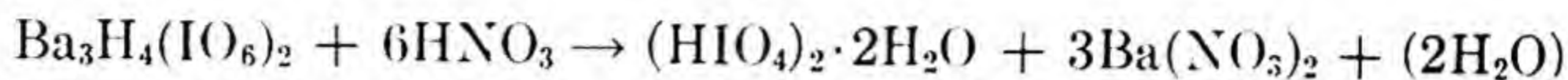
Barium nitride is decomposed by water.



Maquenne, *Compt. rend.*, **114**, 220 (1892) 25

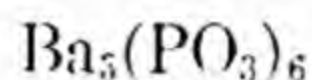
**HNO₃****I-2459**

Periodic acid is formed when barium periodate is treated with concentrated nitric acid.

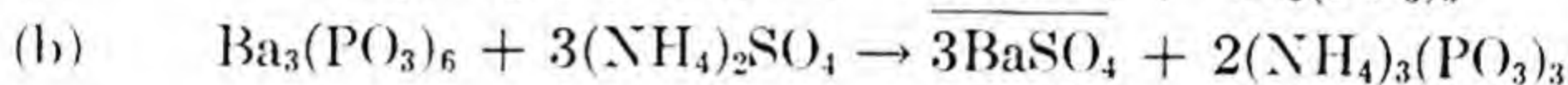


Willard and Thompson, J. Am. Chem. Soc., **56**, 1828 (1934)

1

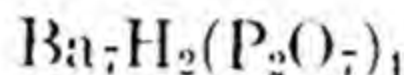
**K₂SO₄****I-2460**

Solutions of barium trimetaphosphate and potassium sulfate are mixed, the barium sulfate filtered off, and the solution yields anhydrous crystalline potassium trimetaphosphate. Ammonium trimetaphosphate is made similarly.

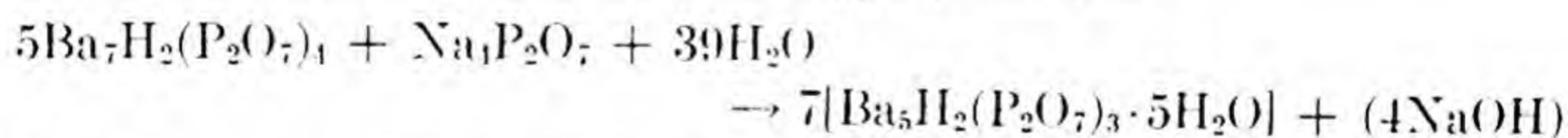


C. G. Lindbom, Acta Univ. Lund., **10**, Part 2, No. 7, 14 (1873)

10

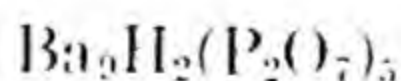
**Na₄P₂O₇****I-2461**

The 7:2:4 barium hydrogen pyrophosphate boiled several hours in normal sodium pyrophosphate solution yields crystalline powdered 5:2:3:5 hydrated barium hydrogen pyrophosphate.

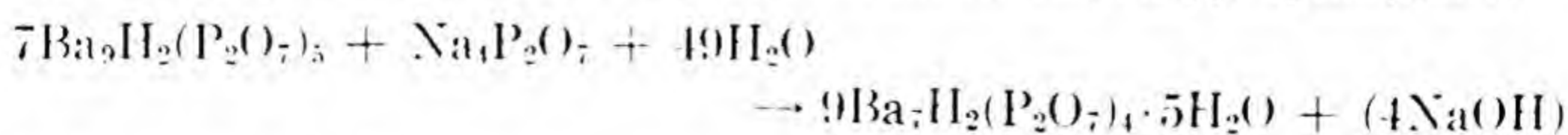


C. N. Pahl, Ark. Kem., Min., Geol., **2**, Part 6, 3 (1905)

10

**Na₄P₂O₇****I-2462**

The 9:2:5 barium hydrogen pyrophosphate on standing in a normal sodium pyrophosphate solution, or on being boiled with it, yields the crystalline pentahydrated 7:2:4:5 barium hydrogen pyrophosphate.



C. N. Pahl, Ark. Kem., Min., Geol., **2**, Part 6, 2 (1905)

10

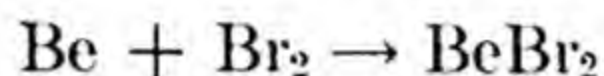
BERYLLIUM

Be

Br

I-2463

Beryllium is heated to a low temperature in presence of bromine vapor.



Pogg. Ann., **13**, 577 (1820)

25

Ref., A. Atterberg, K. Sv. Vet. Akad. Handl., **12**, 16 (1873)

10

Be

C

I-2464

A mixture of beryllium and sugar charcoal is heated in an electric furnace.



Lebeau, Compt. rend., **121**, 496 (1895)

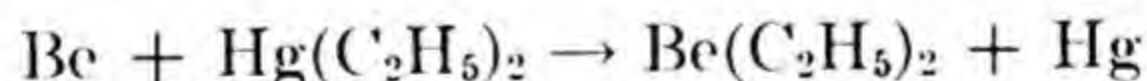
25

Be

$\text{Hg}(\text{C}_2\text{H}_5)_2$

I-2465

Finely divided beryllium is heated to 130–140° with mercury ethyl.



Cahours, Jber. (1873) p. 520

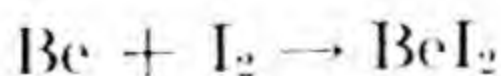
25

Be

I_2

I-2466

Beryllium and iodine unite directly to form beryllium iodide.



A. Atterberg, K. Sv. Vet. Akad. Handl., **12**, 16 (1873)

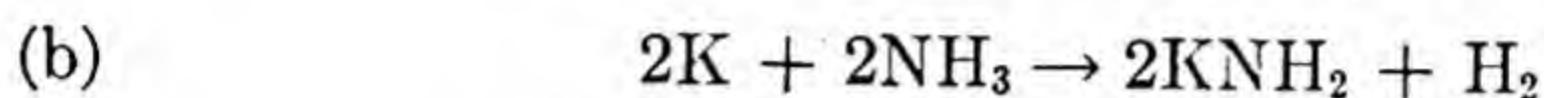
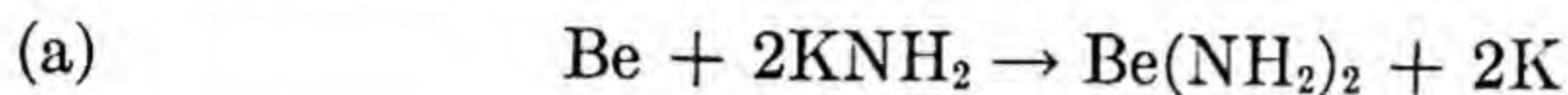
10

Be

KNH₂

I-2467

Beryllium reacts with potassium amide dissolved in liquid ammonia to form an opaque solution containing potassium. This reacts with the solvent to form potassium amide and this salt dissolves the beryllium amide to form potassium ammono beryllate.



F. W. Bergstrom, J. Am. Chem. Soc., **50**, 653 (1928)

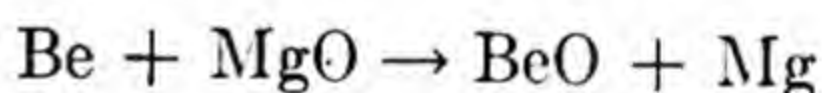
1

Be

MgO

I-2468

Beryllium reduces magnesium oxide at 1900°.



Fichter and Brunner, Z. Anorg. Chem., **93**, 84 (1915)

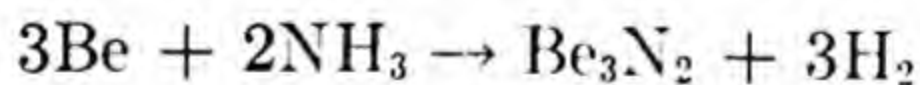
25

Be

NH₃

I-2469

Beryllium is heated to 1000° in an atmosphere of ammonia.



Fichter and Brunner, Z. anorg. Chem., **93**, 84 (1915)

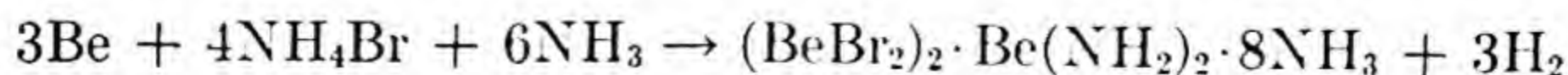
25

Be

NH₄Br

I-2470

Ammonobasic beryllium bromide is formed when a liquid ammonia solution of ammonium bromide is poured upon metallic beryllium.



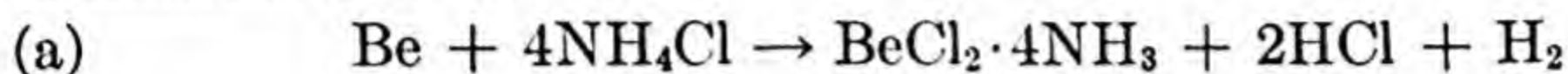
F. W. Bergstrom, J. Am. Chem. Soc., **50**, 659 (1928)

1

Be

NH₄Cl**I-2471**

Beryllium chloride tetrammoniate is formed when beryllium is dissolved in a solution of more than two equivalents of ammonium chloride in liquid ammonia at -40° . When heated in a vacuum at $210-255^{\circ}$ the diammoniate is formed.



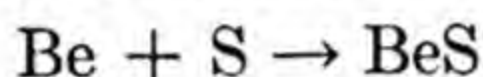
F. W. Bergstrom, J. Am. Chem. Soc., **50**, 657 (1928)

1

Be

S**I-2472**

Beryllium is heated with sulfur to 1300° in a vacuum.

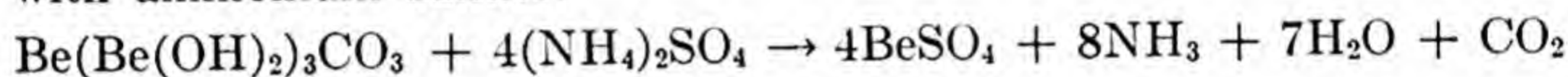


Mielteiner and Steinmetz, Z. Anorg. Chem., **82**, 92 (1913)

25

Be(Be(OH)₂)₃CO₃**(NH₄)₂SO₄****I-2473**

Beryllium sulfate is formed when basic beryllium carbonate is boiled with ammonium sulfate.

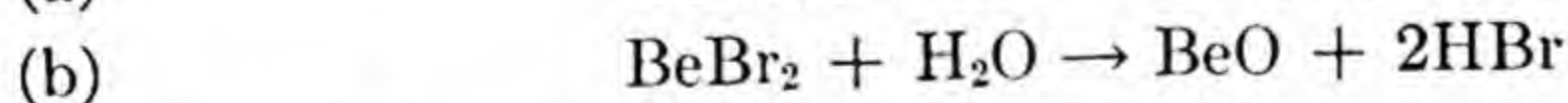
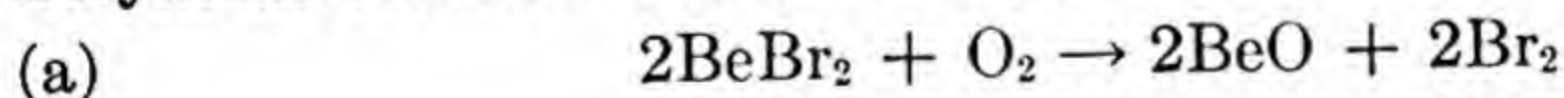


C. L. Parsons, J. Am. Chem. Soc., **26**, 724 (1906)

1

BeBr₂**O****I-2474**

Beryllium bromide is heated in moist air.

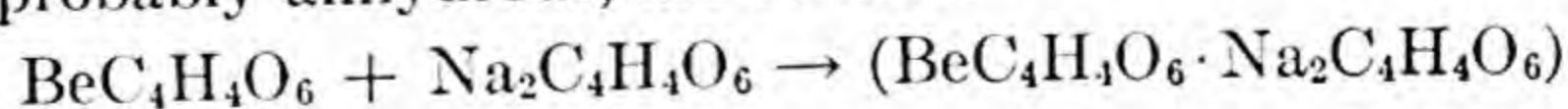


I. Guareschi, Atti. accad. sci. J., **49**, 834 (1914)

25

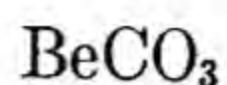
BeC₄H₄O₆**Na₂C₄H₄O₆****I-2475**

When solutions of tartrate of beryllium and of sodium are mixed and evaporated crystalline crusts of the double tartrate of beryllium and sodium, probably anhydrous, are formed.



A. Atterberg, K. Sv. Vet. Akad. Handl. Öfvers., **30**, No. 4, 85 (1873)

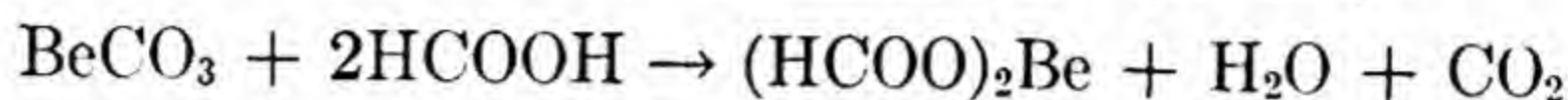
10



HCOOH

I-2476

Beryllium carbonate dissolves in formic acid (50–90°)



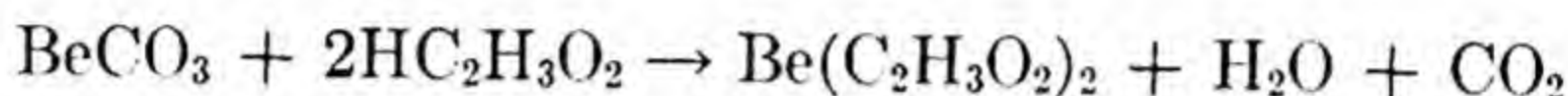
S. Tanatar, *Ber.*, **43**, 1230 (1910)

25

HC₂H₃O₂

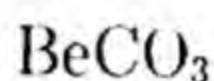
I-2477

Beryllium carbonate is heated to 140° with acetic acid and acetic anhydride in a sealed tube.



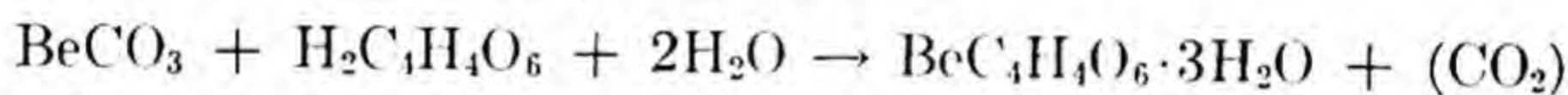
Urban and Lacombe, *Compt. rend.*, **134**, 712 (1902)

25

H₂C₄H₄O₆

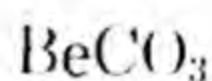
I-2478

Beryllium carbonate, dissolved in an equivalent weight of tartaric acid and evaporated to a syrupy consistency, forms small microscopic crystals of the trihydrated beryllium tartrate.



A. Atterberg, *K. Sv. Vet. Akad. Handl.*, **12**, 37 (1873)

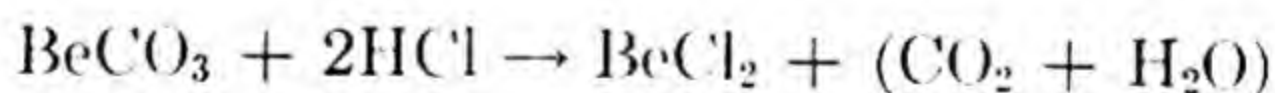
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HCl

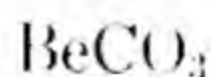
I-2479

Beryllium carbonate dissolves in hydrochloric acid, forming beryllium chloride.



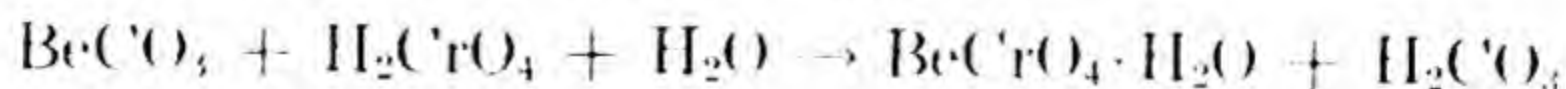
J. K. Wood, *J. Chem. Soc. (London)*, **97**, 881 (1910)

57

H₂CrO₄

I-2480

A warm concentrated solution of chromic acid is neutralized by beryllium carbonate and the solution evaporated.



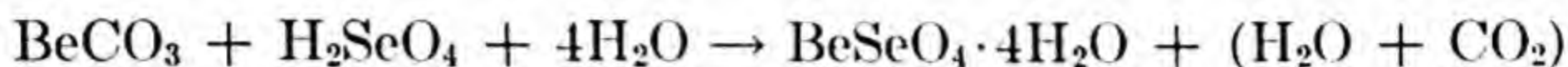
B. Glassmann, *Ber.*, **40**, 2602 (1907)

25



I-2481

Beryllium carbonate, dissolved in an excess of selenic acid and evaporated first by heat and then over sulfuric acid, forms crystalline tetrahydrated beryllium selenate.



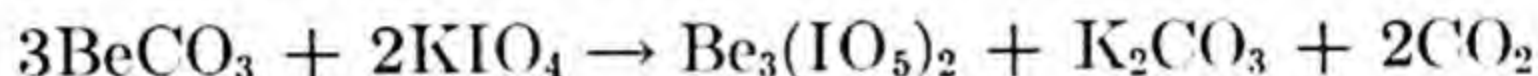
A. Atterberg, K. Sv. Vet. Akad. Handl., **12**, 27 (1873)

10



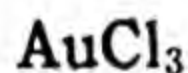
I-2482

When beryllium carbonate is digested with a water solution of potassium iodate, beryllium periodate is obtained.



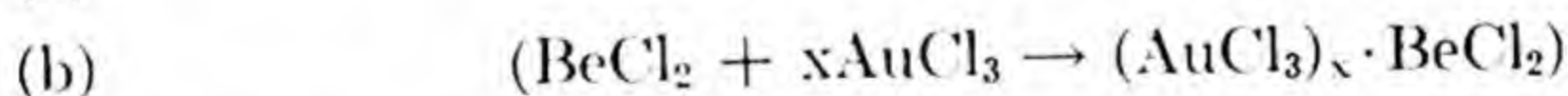
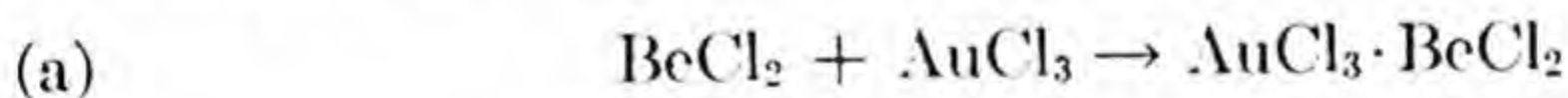
Atterberg, K. Sv. Vet. Akad. Handl. (5) **12** (1873)

10



I-2483

Solutions of gold chloride and beryllium chloride, when mixed and allowed to crystallize on standing, form two distinctly different double gold beryllium chlorides, one containing one molecule of each chloride, the other containing an excess of gold chloride.



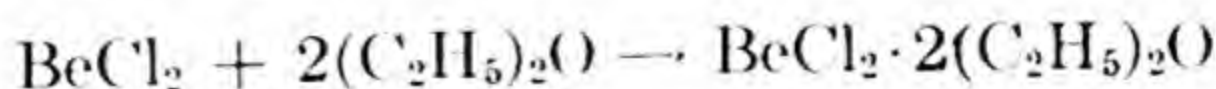
A. Atterberg, K. Sv. Vet. Akad. Handl., **12**, 16 (1873)

10



I-2484

When an ether solution of anhydrous beryllium chloride is evaporated large, clear, hexagonal prisms separate,—diether beryllium chloride.

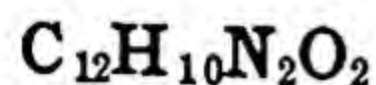


A. Atterberg, K. Sv. Vet. Akad. Handl., Öfvers., **32**, No. 7, 33 (1875)

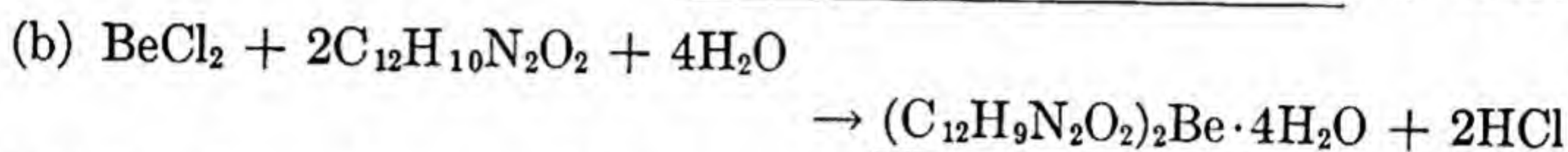
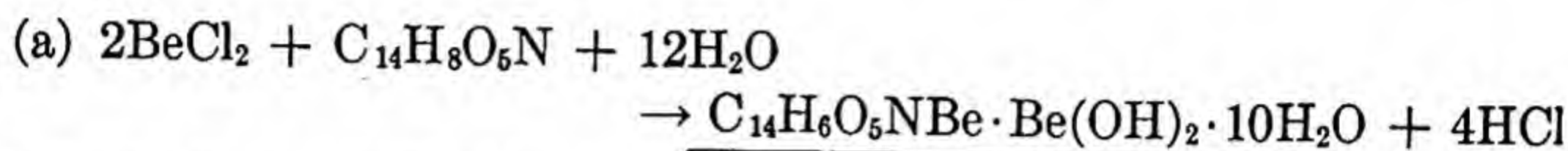
10



I-2485



Beryllium chloride reacts with chinalizarine imine, yielding a precipitate. The same type reaction occurs with naphthazarine ethylene diimine.



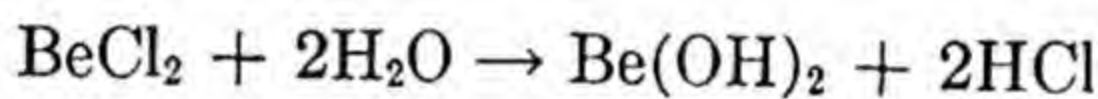
I. V. Dubsky, A. Langer and E. Wagner, *Mikrochem.*, **22**, 108 (1937)

28



I-2486

Beryllium chloride hydrolyzes.



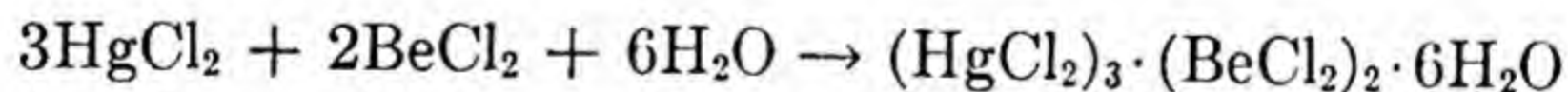
Ley, *Z. phys. chem.*, **30**, 199 (1899)

25



I-2487

When solutions of beryllium chloride and mercuric chloride are mixed and evaporated to a syrupy consistency rhombic tablets of the 3:2 double salt containing probably six molecules of water of hydration are formed.



A. Atterberg, *K. Sv. Vet. Akad. Handl.*, **12**, 15 (1873)

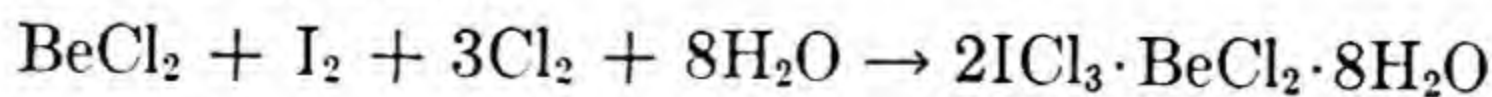
10



I-2488



Dissolve 5 g beryllium chloride in 5 cc of water and 2 cc hydrochloric acid (d = 1.19), add 13 grams of iodine. Pass a stream of chlorine gas through the solution. Needles of yellow color, iodine trichloride-beryllium chloride are obtained.

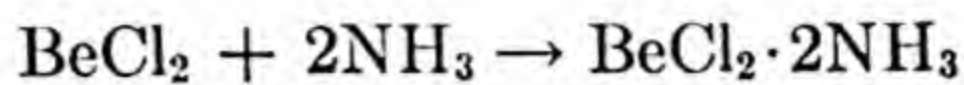


R. F. Weinland and F. Schlegelmilch, *Z. anorg. Chem.*, **30**, 134 (1902)

28

**NH₃****I-2489**

Beryllium chloride is heated to 200° in a sealed tube in the presence of ammonia.

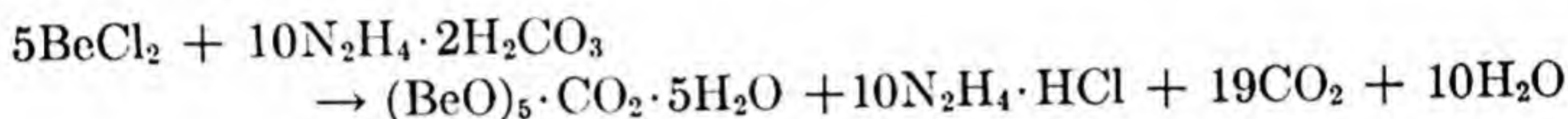


Mielteiner and Steinmetz, *Z. anorg. Chem.*, **80**, 72 (1913)

25

**(N₂H₄) · 2H₂CO₃****I-2490**

Hydrazine carbonate precipitates basic beryllium carbonate quantitatively from hot solutions of beryllium salts in the presence of ammonium salts.

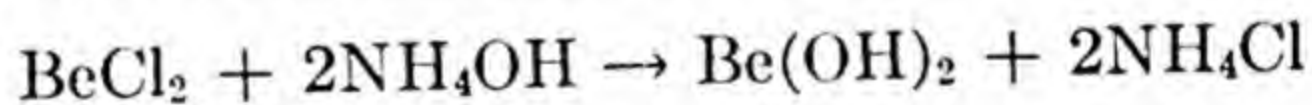


A. Jilek and J. Kota, *Chem. List.*, **24**, 485 (1930)

5

**NH₄OH****I-2491**

Beryllium chloride in solution is treated with ammonium hydroxide.



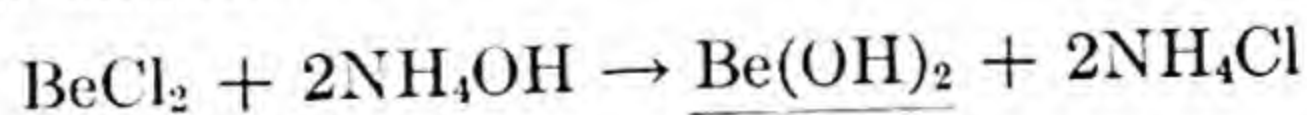
M. Buchner, U. S. Pat. 1,337,191

Ref., *Z. anorg. Chem.*, **80**, 72 (1913)

25

**NH₄OH****I-2492**

Beryllium hydroxide is precipitated from beryllium chloride solution by addition of ammonia.



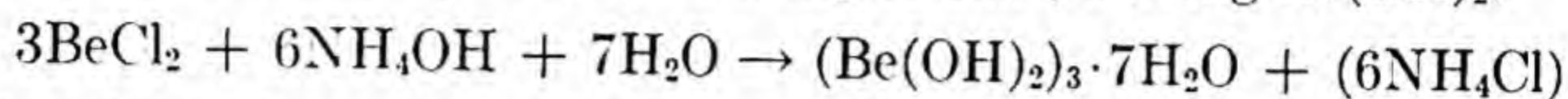
J. K. Wood, *J. Chem. Soc. (London)*, **97**, 883 (1910)

57

NH₄OH

I-2493

Ammonium hydroxide precipitates from a beryllium chloride solution a compound composed of three molecules of beryllium hydroxide united to seven molecules of water of hydration, from which all the water of hydration may be expelled by heating to 100°, leaving Be(OH)₂.



A. Atterberg, K. Sv. Vet. Akad. Handl., **12**, 11 (1873)

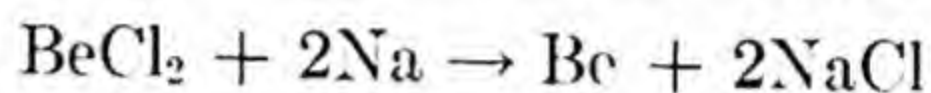
10



Na

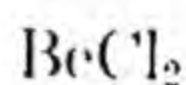
I-2494

Beryllium chloride is heated in a closed iron crucible with sodium.



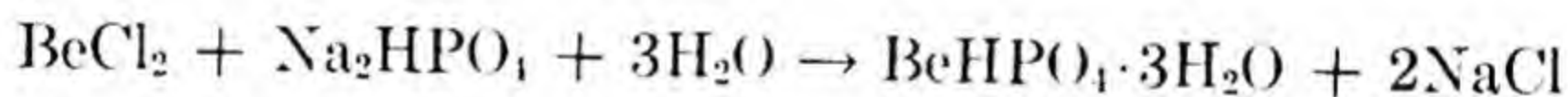
Nilson and Petterson, Ber., **11**, 381 (1878)

26

Na₂HPO₄

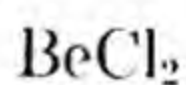
I-2495

Solutions of beryllium chloride and disodium orthophosphate react and the solution is concentrated.



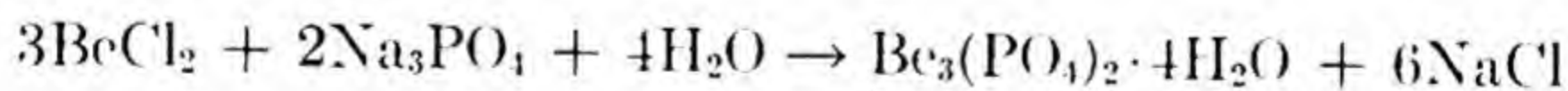
Scheffer, Ann., **109**, 144 (1859)

25

Na₃PO₄

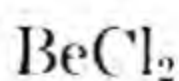
I-2496

Solutions of beryllium chloride and trisodium orthophosphate are added together and concentrated.



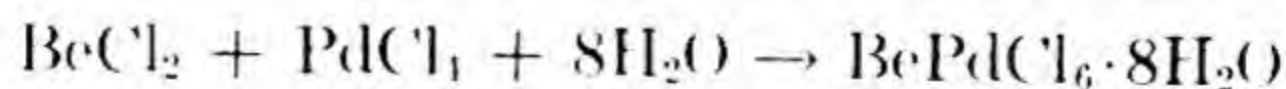
Sestini, Gazz. chim. ital., **26**, 313 (1890)

21

PdCl₄

I-2497

When a mixture of beryllium chloride and palladium tetrachloride is concentrated over sulfuric acid, a double salt is formed.



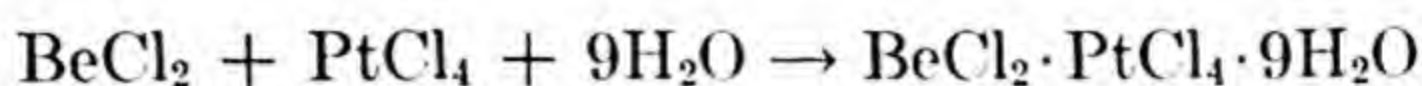
A. Welkow, Ber., **7**, 38 (1874)

11

PtCl₄

I-2498

Beryllium chloride forms a double salt with platinic chloride when solutions of the two are mixed and concentrated.



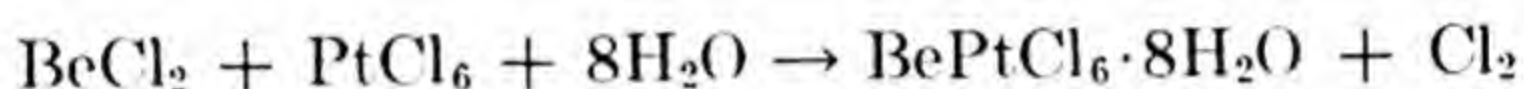
Julius Thomsen, *Ber.*, **3**, 827 (1870)

11

PtCl₄

I-2499

When concentrated solutions of beryllium and platinic chlorides are mixed a double salt is formed.



A. Welkow, *Ber.*, **6**, 1288 (1873)

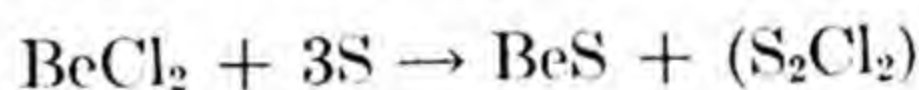
11



S

I-2500

Beryllium chloride is heated strongly with sulfur.



Mielteiner and Steinmetz, *Z. anorg. chem.*, **82**, 92 (1913)

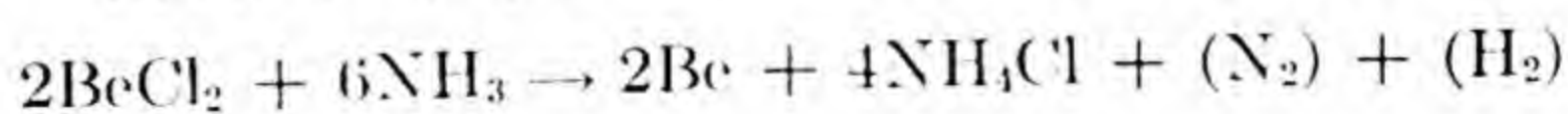
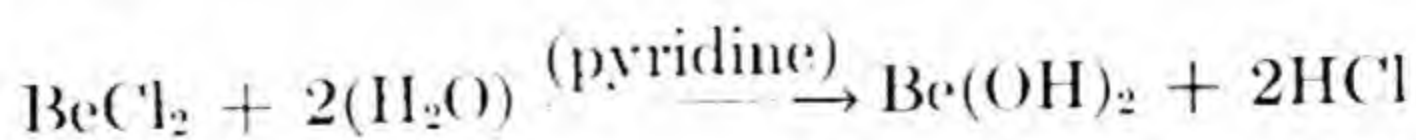
25



E

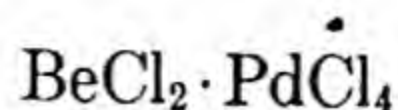
I-2501

Solutions of various beryllium salts in various organic solvents in general yield gelatinous, colloidal substances upon electrolysis suggesting the impractical separation of metallic beryllium in this way. Pure deposits of metal are obtained by electrolyzing liquid ammonia solutions of the chloride or nitrate.



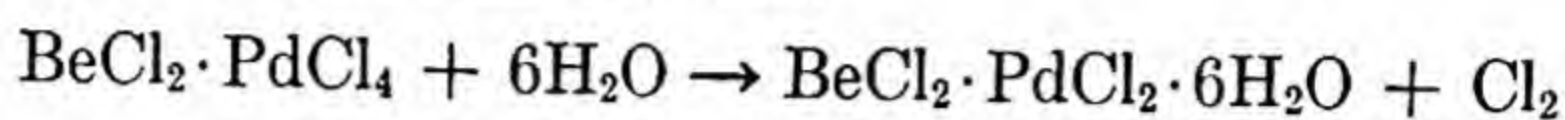
H. S. Booth and G. G. Torrey, *J. Phys. Chem.*, **35**, 2495, 3120 (1931)

85

 Δ

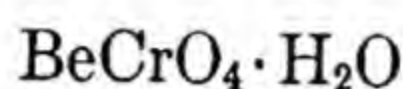
I-2502

Beryllium palladic chloride on heating evolves chlorine and leaves beryllium palladous chloride in solution.



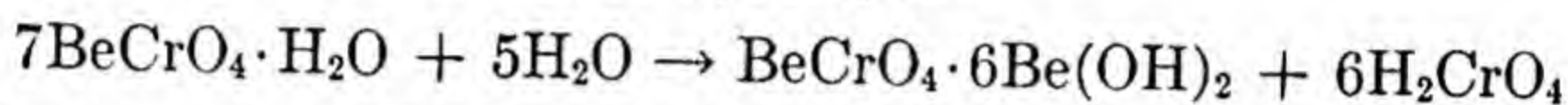
A. Welkow, Ber., 7, 804 (1874)

11

 H_2O

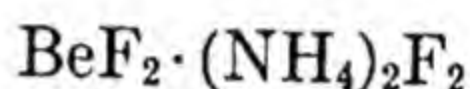
I-2503

Hydrated beryllium chromate hydrolyzes.



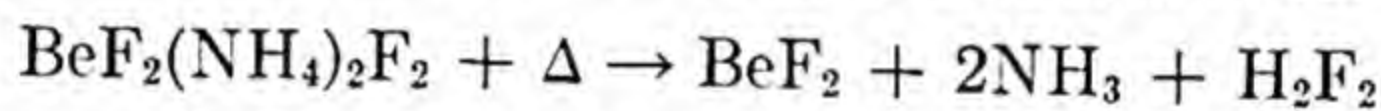
B. Glassman, Ber., 40, 2602 (1907)

25

 Δ

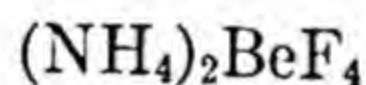
I-2504

Beryllium ammonium fluoride is heated in a stream of carbon dioxide.



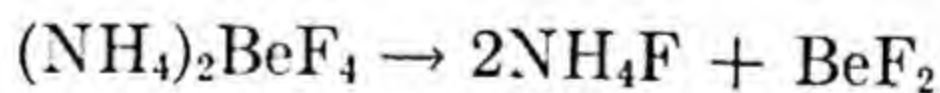
Lebeau, Compt. rend., 126, 1418 (1898)

25

 Δ

I-2505

$(\text{NH}_4)_2\text{BeF}_4$ is heated to 240° in a current of dry carbon dioxide. The temperature is then slowly raised to 400° .



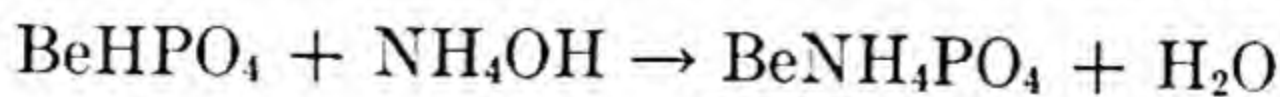
A. V. Novoselova and M. Y. Averkova, J. Gen. Chem. (U.S.S.R.) 9, 1064 (1939)

60

 NH_4OH

I-2506

Beryllium acid orthophosphate is dissolved in hydrochloric acid and the solution neutralized with ammonium hydroxide and then boiled.



Rossler, Z. anal. chem., 17, 148 (1878)

25



I-2507

Beryllium iodide is heated in a stream of cyanogen.



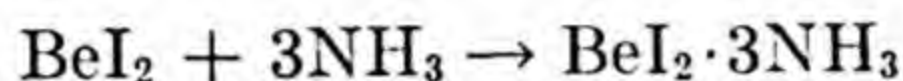
Lebeau, Compt. rend., **126**, 1272 (1898)

25



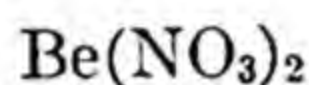
I-2508

Beryllium iodide absorbs ammonia.



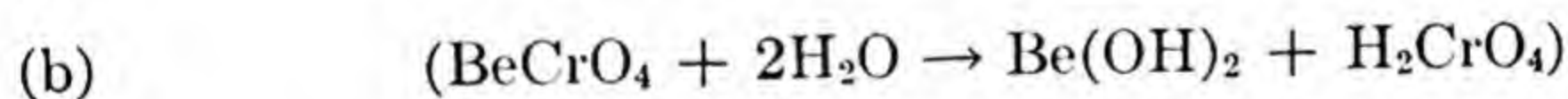
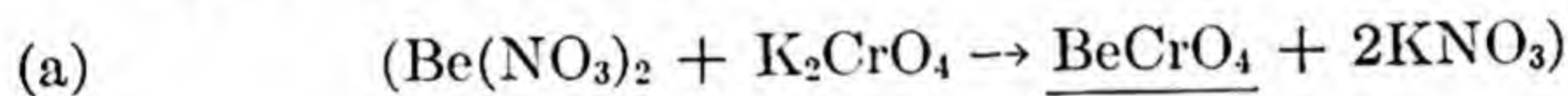
Lebeau, Compt. rend., **126**, 1272 (1898)

25



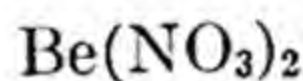
I-2509

A precipitate is formed when a solution of beryllium nitrate is mixed with a 0.25 *M.* solution of potassium chromate, (a). The precipitate is hydrolyzed by washing (b):



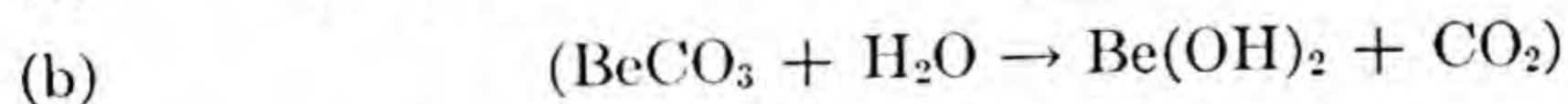
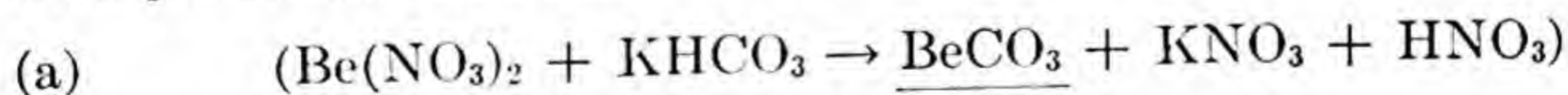
P. E. Gagnon, L. Cloutier and R. Martineau, Can. J. Res., **B19**, 179 (1941)

69



I-2510

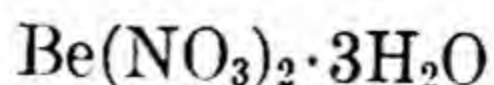
Beryllium nitrate solutions form stable compounds when treated with potassium bicarbonate or ammonium carbonate:



C. L. Parsons, J. Am. Chem. Soc., **26**, 721 (1904)

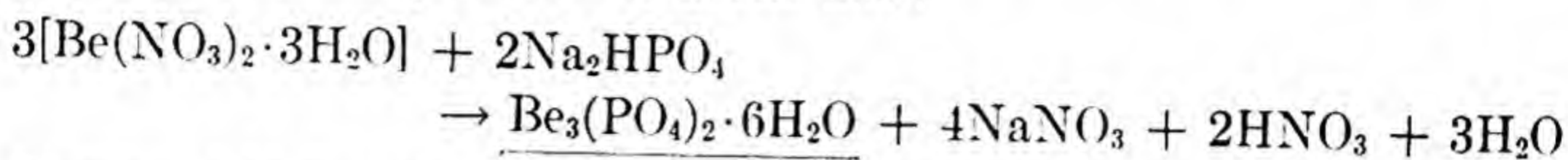
Ref.: P. E. Gagnon, L. Cloutier and R. Martineau, Can. J. Research, **B19**, 179 (1941)

69



I-2511

Hydrated beryllium nitrate in solution reacts with disodium orthophosphate in the presence of acetic acid.



Bleyer and Muller, *Z. anorg. chem.*, **79**, 263 (1912)

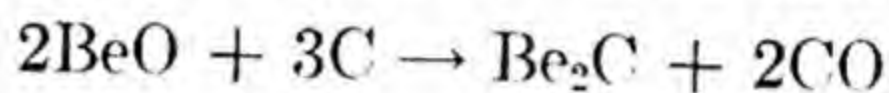
25



C

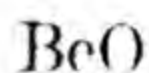
I-2512

Beryllium oxide is heated with sugar charcoal in the electric furnace.



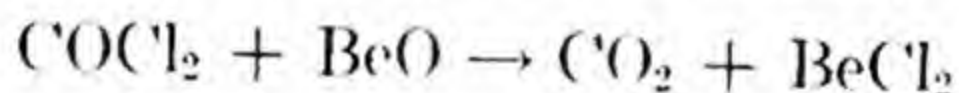
Lebeau, *Compt. rend.*, **121**, 496 (1895)

25



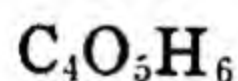
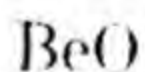
I-2513

Pure crystals of beryllium chloride are prepared by passing dry phosphene over thoroughly dried beryllium oxide at 450°C.



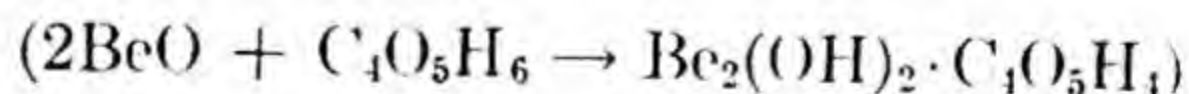
H. S. Booth and G. G. Torrey, *J. Phys. Chem.*, **35**, 2469 (1931)

85



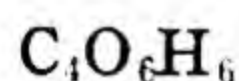
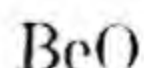
I-2514

Beryllium oxide dissolves in a solution of malic acid, forming a basic malate.



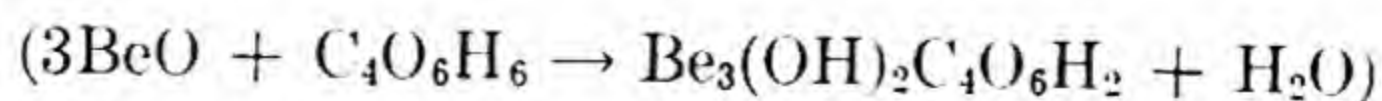
J. L. Delsal, *J. Chim. phys.*, **35**, 314 (1938)

69



I-2515

Beryllium oxide is soluble in a solution of tartaric acid, with formation of a basic salt:



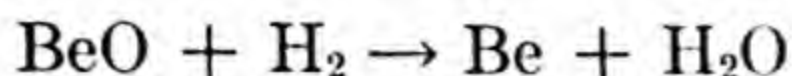
J. L. Delsal, *J. Chim. phys.*, **35**, 314 (1938)

69

BeO

H₂**I-2516**

Beryllium oxide is reduced by hydrogen.



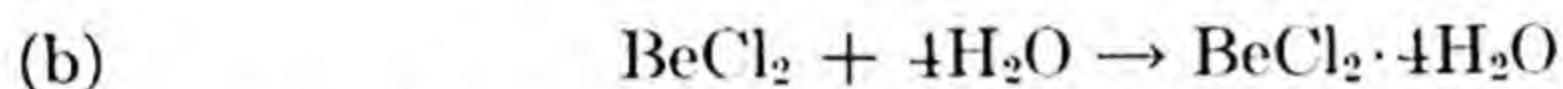
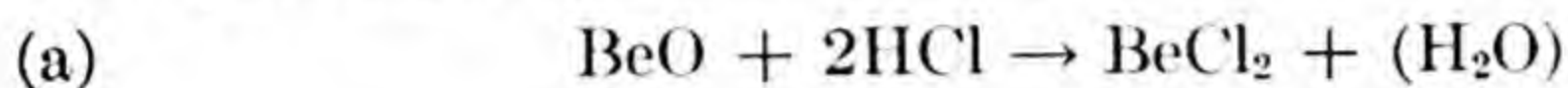
W. N. Hartley, *Trans. Roy. Soc. (Dublin)*, **7**, 346 (1901)

25

BeO

HCl**I-2517**

Evaporation of a solution of beryllium oxide in hydrochloric acid forms tetrahydrated beryllium chloride.



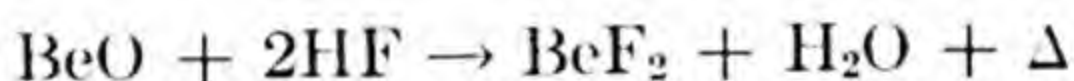
A. Atterberg, *K. Sv. Vet. Akad. Handl.*, **12**, 12 (1873)

10

BeO

HF**I-2518**

Beryllium oxide dissolves in hydrochloric or hydrofluoric acid with evolution of heat:



Copaux and Philips, *Compt. Rend.*, **176**, 579 (1923)

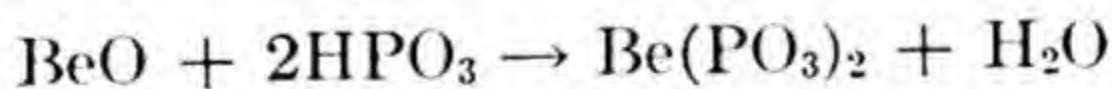
Ref.: G. Marchal, *J. Chim. phys.*, **22**, 325 (1925)

69

BeO

HPO₃**I-2519**

Beryllium oxide is fused with an excess of metaphosphoric acid with addition of some silver orthophosphate.



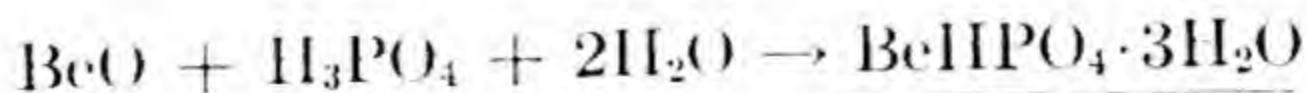
Bleyer and Müller, *Z. anorg. chem.*, **79**, 263

25

BeO

H₃PO₄**I-2520**

A solution of beryllium oxide in phosphoric acid yields on addition of alcohol, a granular mass of trihydrated beryllium hydrogen orthophosphate.



A. Atterberg, *K. Sv. Vet. Akad. Handl. Öfvers.*, **32**, No. 7, 35 (1875)

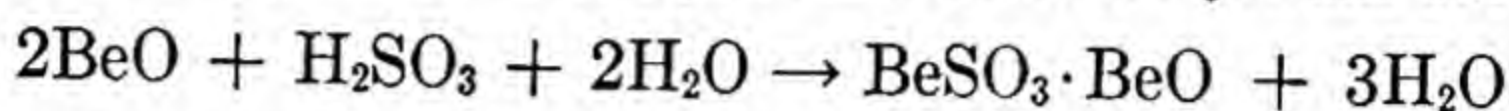
10

BeO

H₂SO₃

I-2521

When beryllium oxide is dissolved in sulfurous acid and the solution evaporated a syrupy mass of trihydrated basic beryllium sulfite results.



A. Atterberg, K. Sv. Vet. Akad. Handl. Öfvers., **30**, No. 4, 83 (1873)

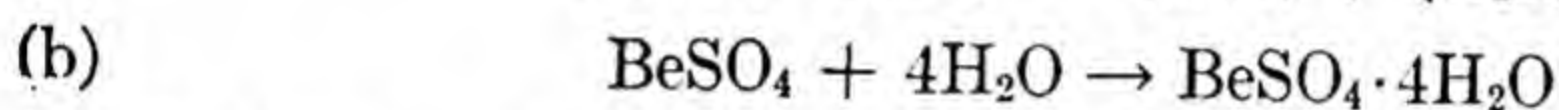
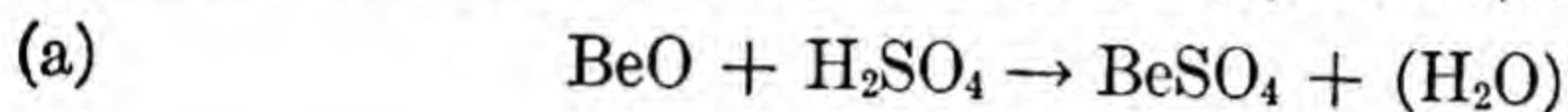
10

BeO

H₂SO₄

I-2522

Beryllium oxide dissolves in sulfuric acid. The resulting solution on evaporation yields blunt-ended, quadratic pyramids with occasional prismatic faces, hydrated, probably tetrahydrated, beryllium sulfate.



A. Atterberg, K. Sv. Vet. Akad. Handl. Öfvers., **30**, No. 4, 80 (1873)

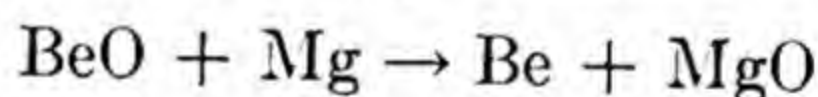
10

BeO

Mg

I-2523

Beryllium oxide is reduced by magnesium.



Winkler, Ber., **23**, 120 (1890)

Denied by P. Lebeau, Compt. rend., **123**, 818 (1896)

25

BeO

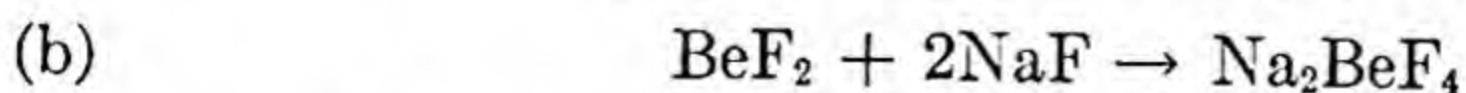
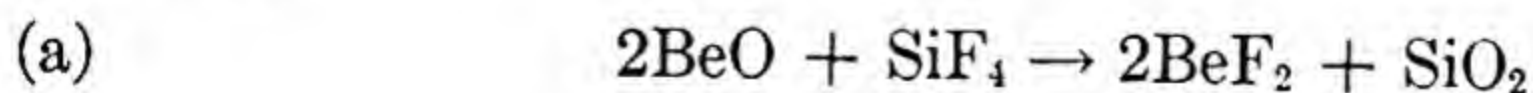
SiF₄

I-2524

NaF

Beryllium may be extracted from beryl by treatment with silicon tetrafluoride and sodium fluoride.

The solubility of sodium beryllium fluoride in water at 100° is 28 grams per liter.



H. Copaux, F. Pat. No. 476,465, July 18, 1914

Ref.: H. Copaux, Chim. et Ind., **2**, 915 (1919)

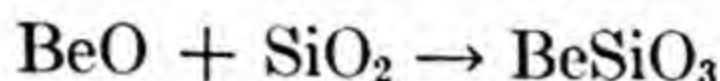
91

BeO

SiO₂

I-2525

Beryllium oxide and quartz are heated together in the electric furnace.



Jager and van Klooster, *J. Soc. Glass Tech.*, **3**, 234

25

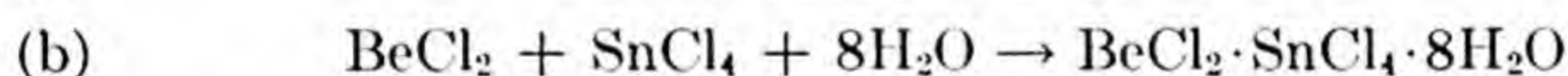
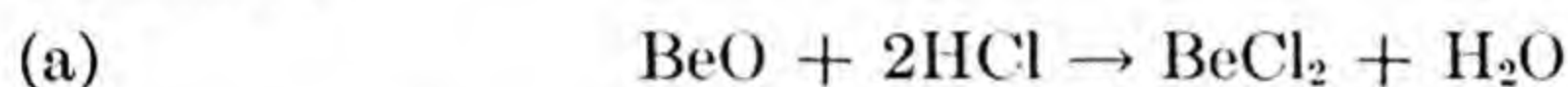
BeO

SnCl₄

I-2526

HCl

When beryllium oxide is dissolved in hydrochloric acid, and stannic chloride is added and the resulting solution evaporated, a double beryllium stannic chloride containing eight molecules of water of hydration is formed.



A. Atterberg, *K. Sv. Vet. Akad. Handl.*, **12**, 14 (1873)

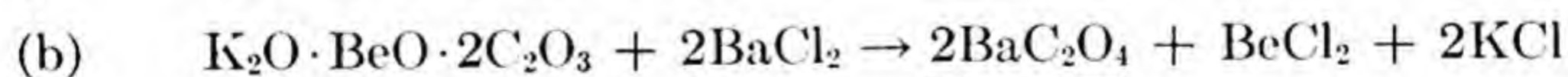
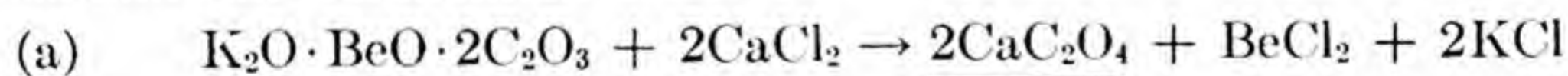
10

K₂O · BeO · 2C₂O₃CaCl₂

I-2527

BaCl₂

A solution of potassium beryllium oxalate will react with a solution of calcium chloride yielding calcium oxalate. The same type reaction occurs with barium chloride. The same type reaction occurs with the sodium and ammonium salts.



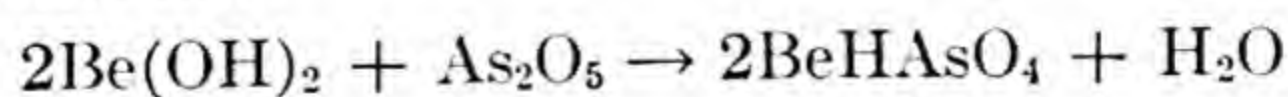
A. Rosenheim and P. Woge, *Z. anorg. Chem.*, **15**, 283 (1897)

28

Be(OH)₂As₂O₅

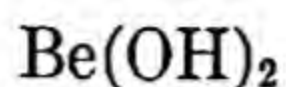
I-2528

Beryllium hydroxide is heated to 220° for several hours in a sealed tube with arsenic pentoxide.



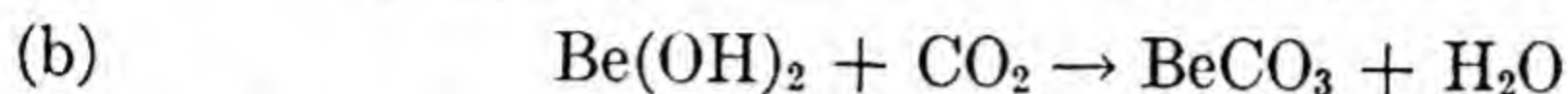
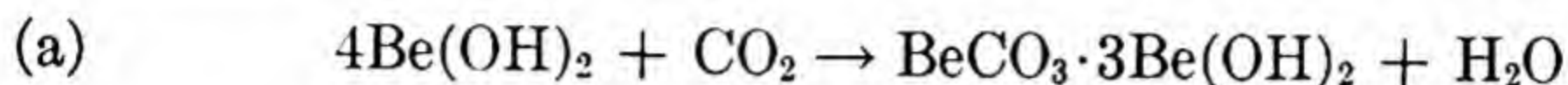
Bleyer and Muller, *Z. anorg. Chem.*, **75**, 287 (1912)

25

CO₂

I-2529

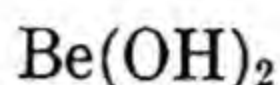
Beryllium hydroxide suspended in water is treated with carbon dioxide.



P. N. Raikow, Chem. Ztg., **31**, 55, 87

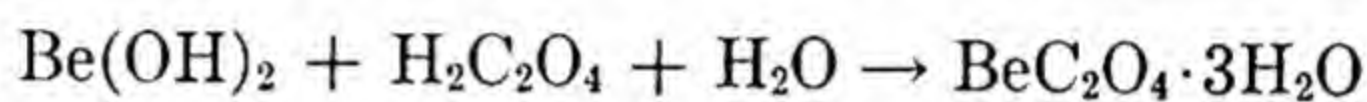
Ref.: Weeren, Pogg. Ann., **92**, 101 (1854)

25

H₂C₂O₄

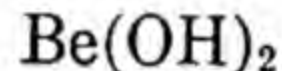
I-2530

Beryllium hydroxide is digested with a boiling solution of oxalic acid.



Rosenheim and Woge, Z. anorg. Chem., **15**, 283 (1897)

25

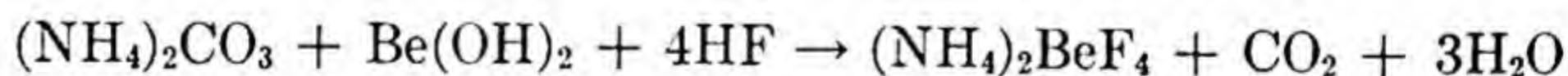


HF

I-2531

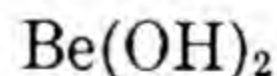
(NH₄)₂CO₃

Pure beryllium hydroxide is dissolved in hydrofluoric acid (d. 1.13) and treated with the theoretical amount of ammonium carbonate. The solution is concentrated, chilled and the precipitated product filtered and washed with cold H₂O, then alcohol.



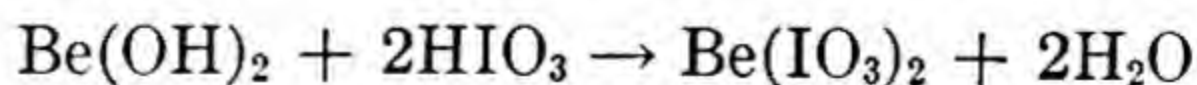
A. V. Novoselova and M. Y. Averkova, J. Gen. Chem. (USSR), **9**, 1063 (1939)

60

HIO₃

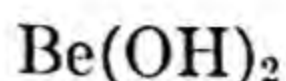
I-2532

Beryllium hydroxide treated with iodic acid evaporates to a non-crystalline, nearly dry syrup containing beryllium iodate.



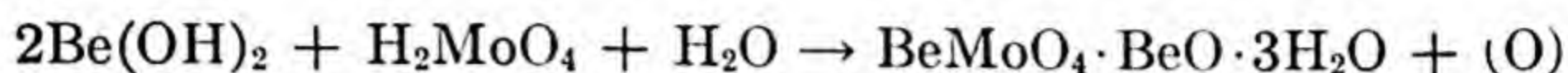
A. Atterberg, K. Sv. Vet. Akad. Handl. Öfvers., **30**, No. 4, 85 (1873)

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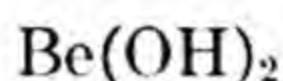
I-2533

When beryllium hydroxide and molybdic acid are boiled in water for some time, the solution yields a voluminous powder consisting of tightly packed needle crystals. This is a trihydrated basic beryllium molybdate.



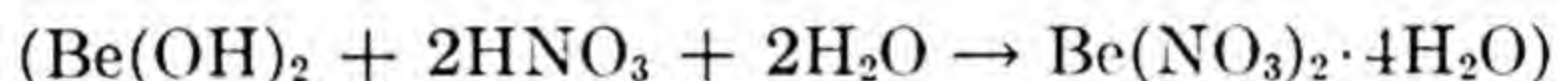
A. Atterberg, K. Sv. Vet. Akad. Handl. Öfvers., **30**, No. 4, 84 (1873)

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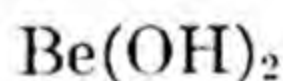
I-2534

Beryllium hydroxide is dissolved in nitric acid (d. 1.52) under ice cooling. Partial evaporation yields hygroscopic crystals of beryllium nitrate, as tetrahydrate. Crystallization from 51% HNO_3 yields the trihydrate.



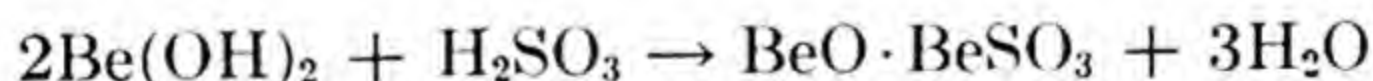
A. V. Novoselova, N. D. Nagorskaya and N. M. Meteleva, J. Gen. Chem. (USSR), **6**, 1307 (1936)

60



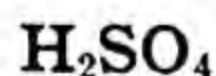
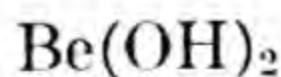
I-2535

Beryllium hydroxide is digested with sulfurous acid, yielding basic beryllium sulfite.



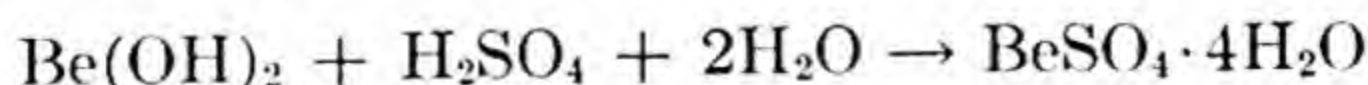
G. Kruss and H. Moraht, Ber., **23**, 727 (1890)

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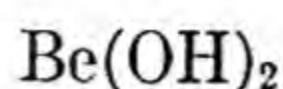
I-2536

Beryllium hydroxide dissolves in dilute sulfuric acid.



H. Debray, Ann. chim. [3] **44**, 5 (1855)

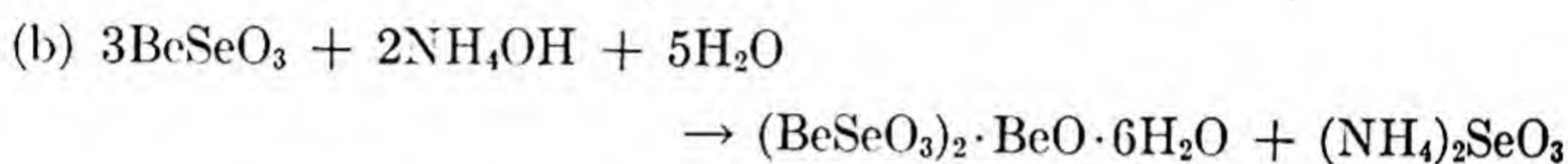
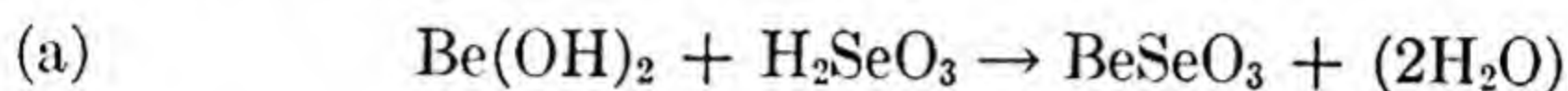
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I-2537

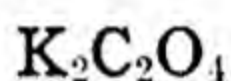
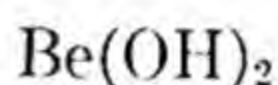


When equivalent amounts of beryllium hydroxide and of selenous acid are mixed and evaporated a non-crystallizable solution results. Addition of ammonia to this precipitates a white flocculent powder, hexahydrated basic beryllium selenite.

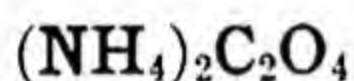
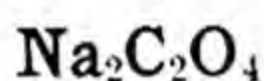


A. Atterberg, K. Sv. Vet. Akad. Handl. Öfvers., **30**, No. 4, 83 (1873)

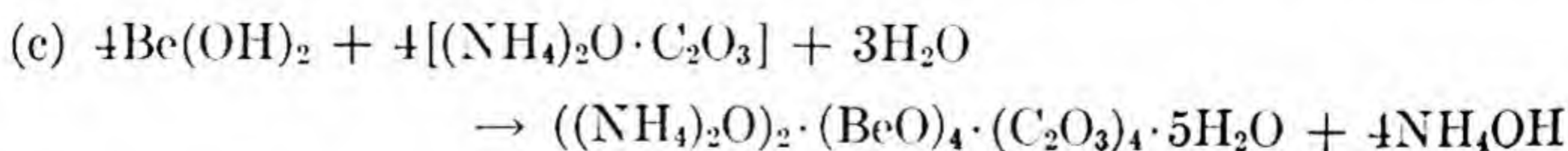
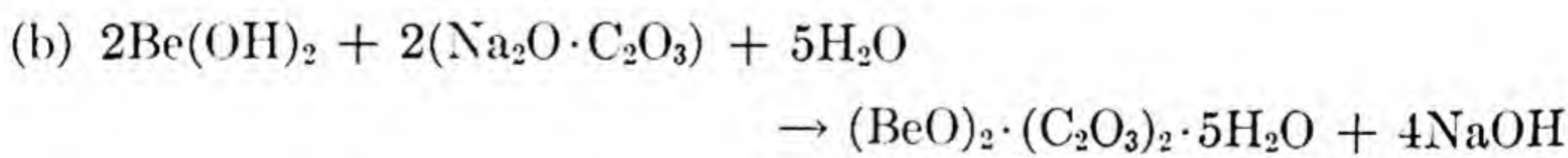
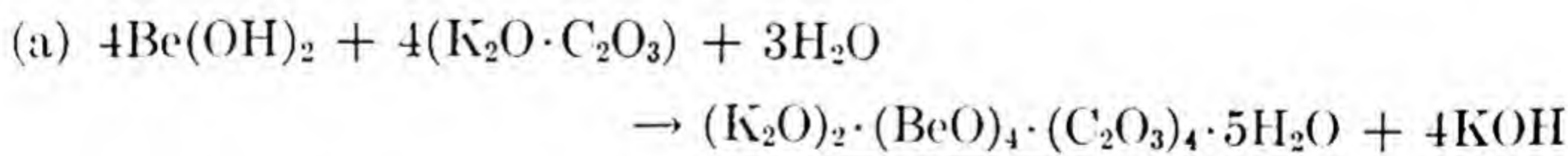
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I-2538

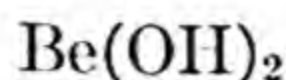


By saturating a solution of potassium oxalate with beryllium hydroxide at 100°, colorless crystals will be obtained when exposed to concentrated sulfuric acid. The same type reaction occurs with sodium oxalate and ammonium oxalate.



A. Rosenheim and P. Woge, Z. anorg. Chem., **15**, 283 (1897)

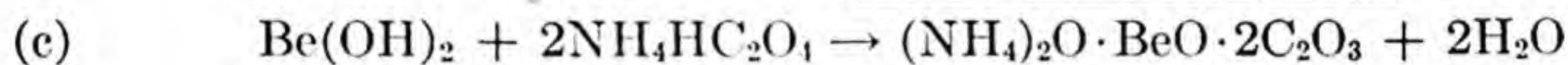
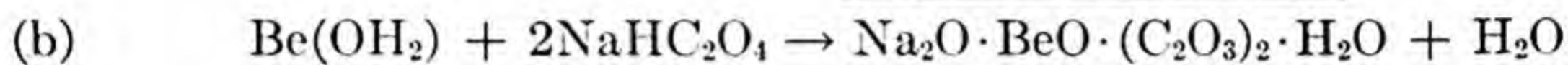
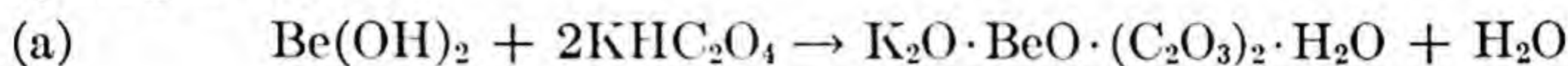
28



I-2539

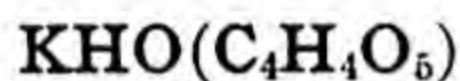
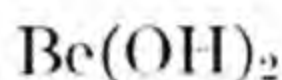


A solution of potassium hydrogen oxalate is saturated with beryllium hydroxide, then filtered off, and the filtrate decomposed with potassium hydrogen oxalate. Colorless crystals are obtained. The same type reaction occurs with sodium hydrogen oxalate and ammonium hydrogen oxalate.



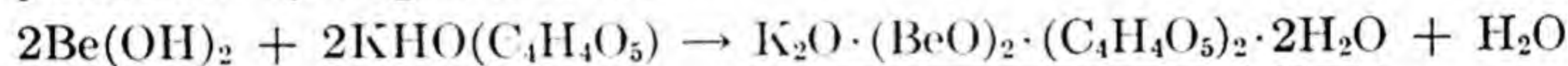
A. Rosenheim and P. Woge, *Z. anorg. Chem.*, **15**, 283 (1897)

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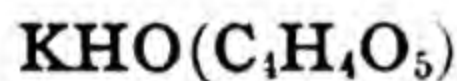
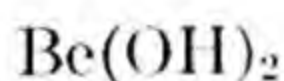
I-2540

A glasslike substance is obtained when a measured quantity of beryllium hydroxide is dissolved in a measured quantity of a solution of potassium hydrogen tartrate.

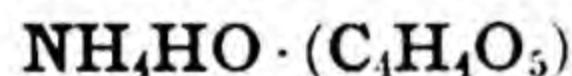
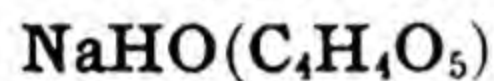


A. Rosenheim and P. Woge, *Z. anorg. Chem.*, **15**, 283 (1897)

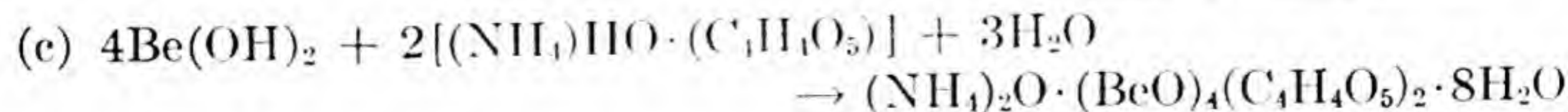
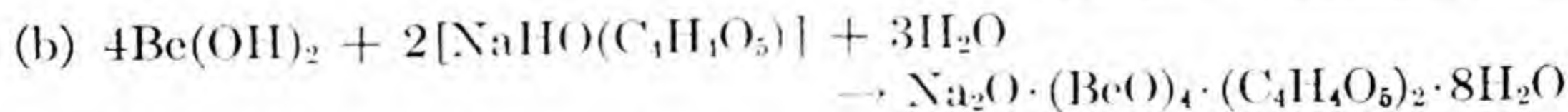
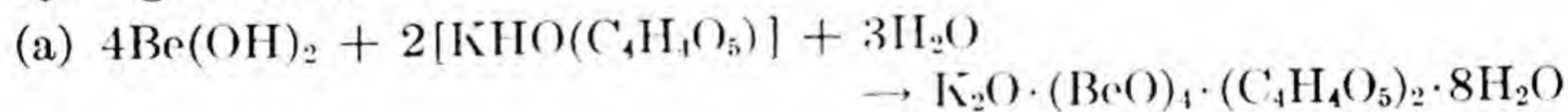
28



I-2541

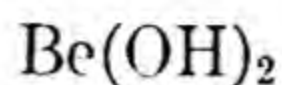


A solution of potassium hydrogen tartrate is saturated with beryllium hydroxide at 100°, then filtered off. Crystals are obtained. The same type reaction occurs with sodium hydrogen tartrate and ammonium hydrogen tartrate.

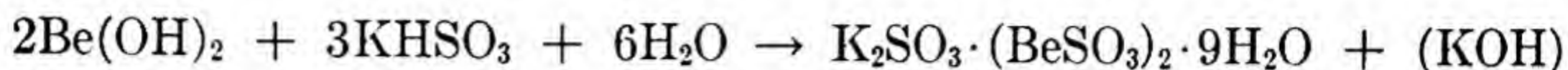


A. Rosenheim and P. Woge, *Z. anorg. Chem.*, **15**, 283 (1897)

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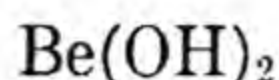
**KHSO₃****I-2542**

Beryllium hydroxide is digested with a warm solution of potassium bisulfite.

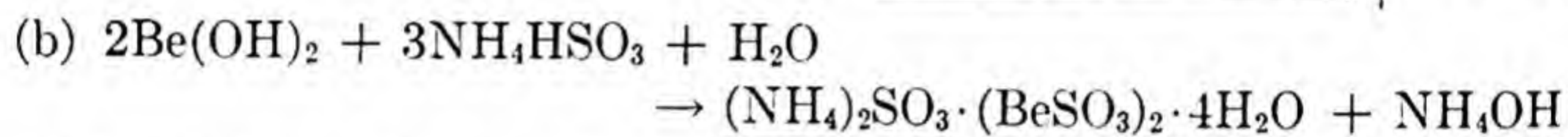
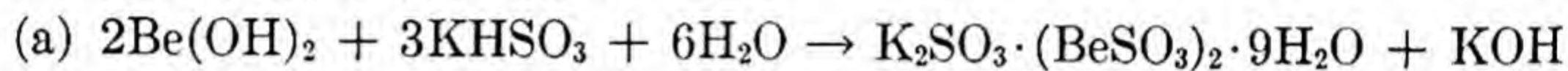


Seubert and Elten, *Z. anorg. Chem.*, **4**, 44 (1893)

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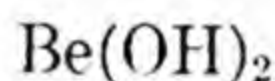
**KHSO₃****I-2543****NH₄HSO₃**

Crystals are formed when beryllium hydroxide reacts with a solution of potassium hydrogen sulfite. The same type reaction occurs with ammonium hydrogen sulfite.

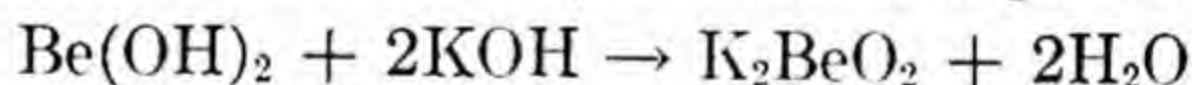


A. Rosenheim and P. Woge, *Z. anorg. Chem.*, **15**, 283 (1897)

28

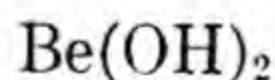
**KOH****I-2544**

Beryllium hydroxide is dissolved by a solution of potassium hydroxide.

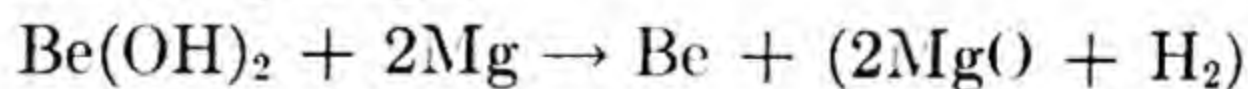


Kruss and Moraht, *Ann.*, **260**, 161 (1890)

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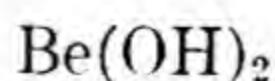
**Mg****I-2545**

Beryllium hydroxide is readily reduced by magnesium when heated in an atmosphere of hydrogen.

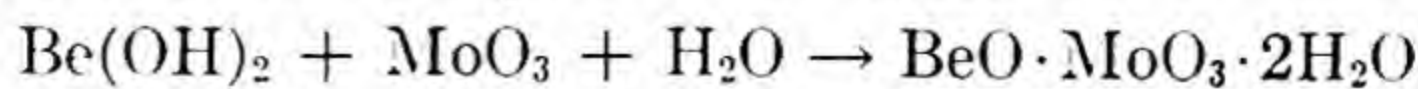


H. F. Keller, *J. Am. Chem. Soc.*, **16**, 838 (1894)

1

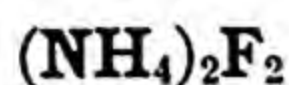
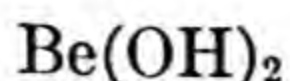
**MoO₃****I-2546**

Needles are obtained when beryllium hydroxide is heated with molybdenum trioxide which is suspended in water.



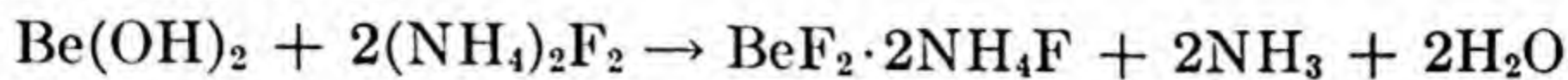
A. Rosenheim and P. Woge, *Z. anorg. Chem.*, **15**, 283 (1897)

28



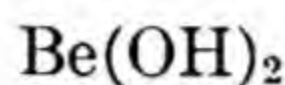
I-2547

Colorless needles are obtained after beryllium hydroxide has been dissolved in a hot solution of ammonium fluoride and the excess of water has been evaporated.



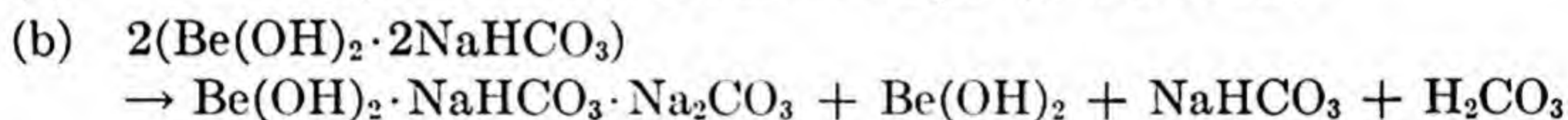
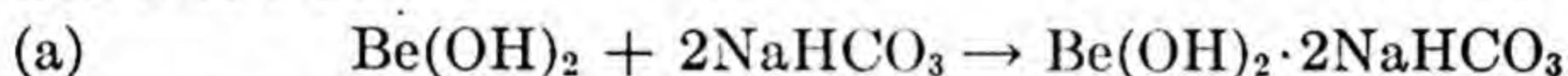
H. V. Helmholt, *Z. anorg. Chem.*, **3**, 115 (1893)

28



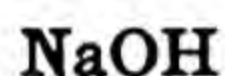
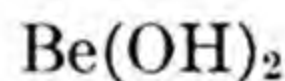
I-2548

Beryllium hydroxide is dissolved in 1.08 *N* sodium bicarbonate solution below 53°.



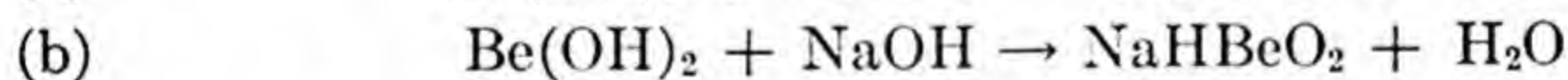
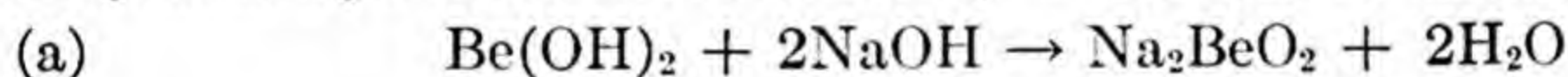
A. Baladien, *Chem. News*, **132**, 213 (1926)

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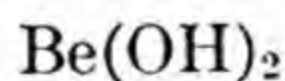
I-2549

Beryllium hydroxide is dissolved by a solution of sodium hydroxide.



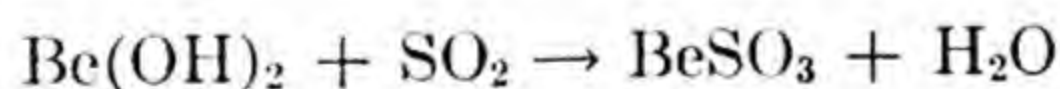
J. K. Wood, *J. Chem. Soc.*, (London), **97**, 883 (1910)

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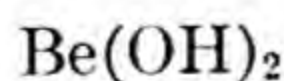
I-2550

Beryllium hydroxide is digested with a solution of sulfur dioxide in absolute alcohol.



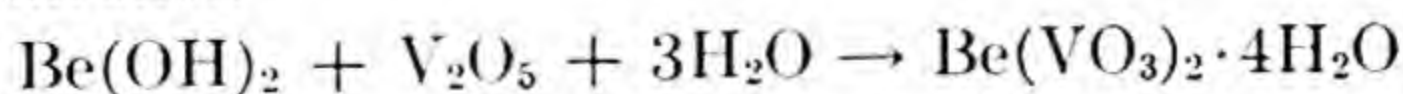
Kruss and Moraht, *Ber.*, **23**, 734 (1890)

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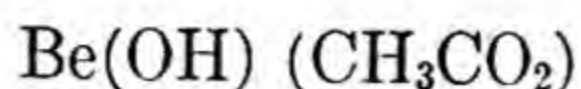
I-2551

A boiling solution containing equivalent proportions of beryllium hydroxide and vanadium pentoxide is filtered, concentrated and poured slowly into alcohol.

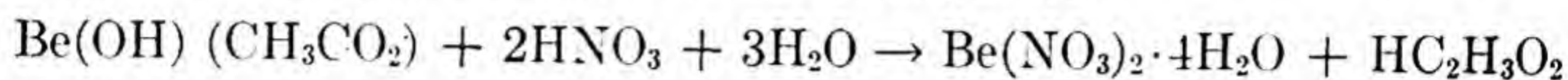


P. H. M. P. Brenton, *J. Am. Chem. Soc.*, **38**, 2361 (1916)

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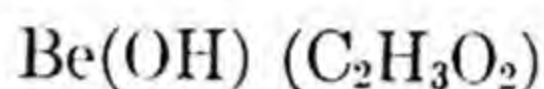
**HNO₃****I-2552**

Hydroxy beryllium acetate is evaporated with nitric acid (d. 1.4), and the syrup treated with little HNO₃. Upon scratching the sides of the beaker it crystallizes to the nitrate tetrahydrate.

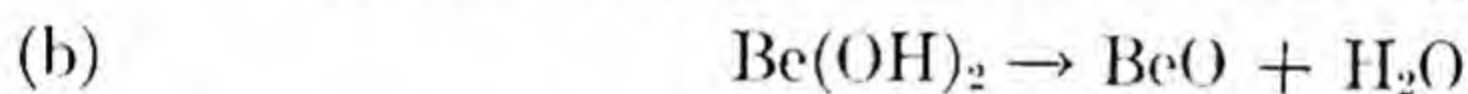
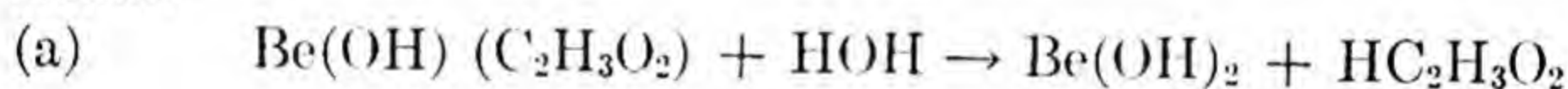


A. V. Novoselova, N. D. Nagorskaya and N. M. Meteleva, *J. Gen. Chem. (USSR)* **6**, 1307 (1936)

60

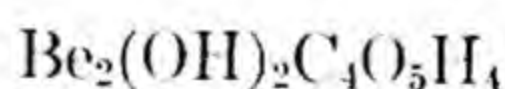
**H₂O****I-2553**

A granular beryllium hydroxide of satisfactory purity for preparation of other beryllium salts is obtained by hydrolyzing basic beryllium acetate, (purified by crystallization from hot acetic acid) or by electrolyzing (6.4 amps/dm², ice cooled), or by dialyzing in an atmosphere of steam.

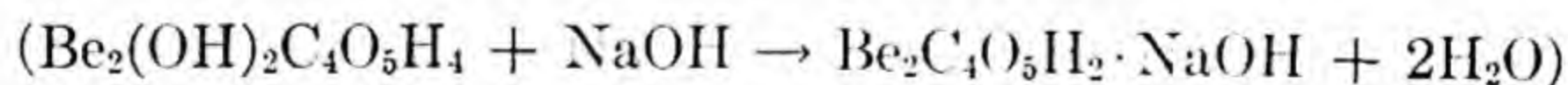


H. S. Booth and G. G. Torrey, *J. Phys. Chem.*, **35**, 2467 (1931)

85

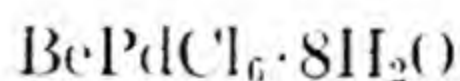
**NaOH****I-2554**

The neutralization curve of the basic beryllium malate by sodium hydroxide shows formation of a complex in solution:

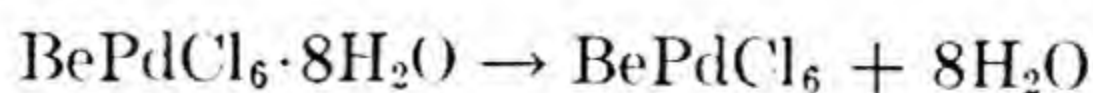


J. L. Delsal, *J. Chim. phys.*, **35**, 314 (1938)

69

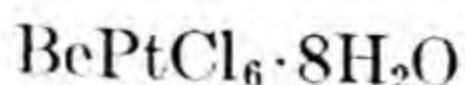
**Δ****I-2555**

Beryllium palladium hexachloride octahydrate loses all its water of hydration at 130°C.



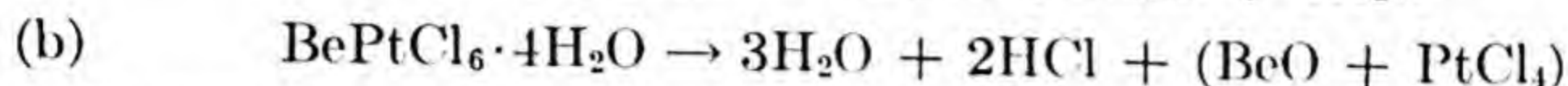
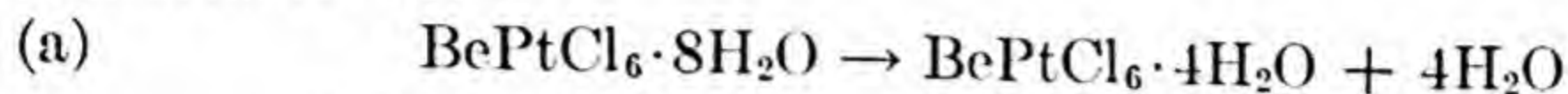
A. Welkow, *Ber.*, **7**, 38 (1874)

11

 Δ

I-2556

Beryllium platinic chloride octahydrate loses 4 moles of water at 100°C. The tetrahydrate decomposes above 150°C with loss of water and hydrochloric acid.



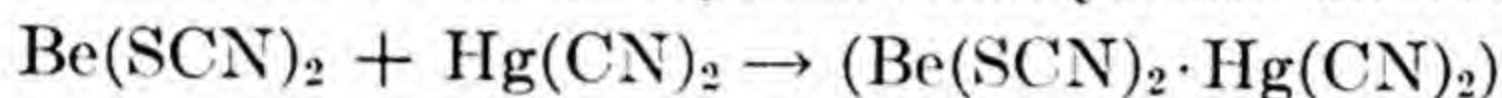
A. Welkow, Ber., **6**, 1189 (1873)

11

 $\text{Hg}(\text{CN})_2$

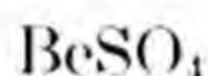
I-2557

When beryllium thiocyanate solution and mercuric cyanide solution are mixed and evaporated, crystalline tablets with mother-of-pearl luster are formed—the double salt, beryllium thiocyanate mercuric cyanide.



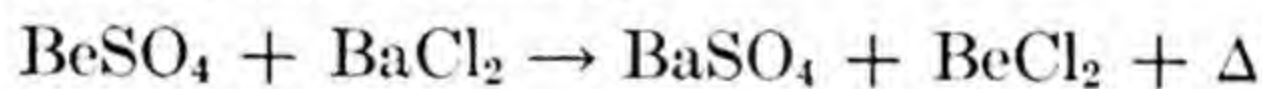
A. Atterberg, K. Sv. Vet. Akad. Handl. Öfvers., **30**, No. 4, 85 (1873)

10

 BaCl_2

I-2558

The double decomposition between beryllium sulfate and barium chloride is an exothermic reaction:



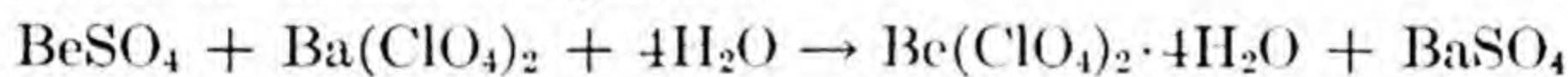
G. Marchal, J. Chim. phys., **22**, 325 (1925)

69

 $\text{Ba}(\text{ClO}_4)_2$

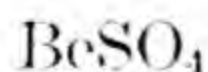
I-2559

Solutions of beryllium sulfate and barium perchlorate are added together and the filtrate evaporated.



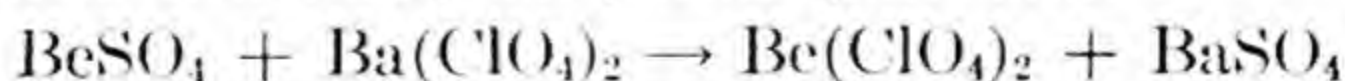
Marignac, Ann. chim. [4] **30**, 45 (1873)

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 $\text{Ba}(\text{ClO}_4)_2$

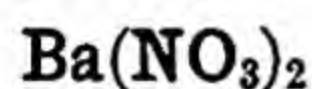
I-2560

Double replacement between beryllium sulfate and barium perchlorate forms on slow evaporation small needle crystals of beryllium perchlorate which can be dried only on porous porcelain.



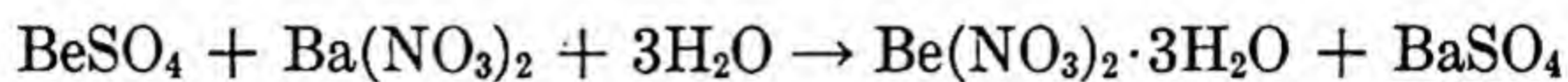
A. Atterberg, K. Sv. Vet. Akad. Handl., **12**, 20 (1873)

10



I-2561

Equivalent amounts of beryllium sulfate and barium nitrate in solution react and the filtrate evaporates.



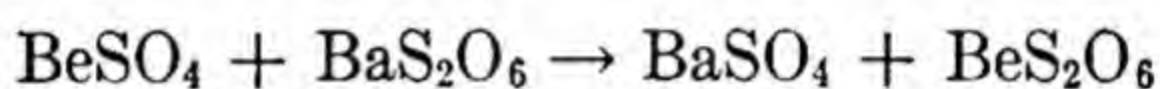
Atterberg, K. Sv. Vet. Akad. Handl. [5] **12**, (1873)

25



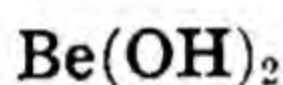
I-2562

When solutions of beryllium sulfate and of barium dithionate are mixed, the barium sulfate filtered off, and the solution evaporated over sulfuric acid, crystals of beryllium dithionate are formed.



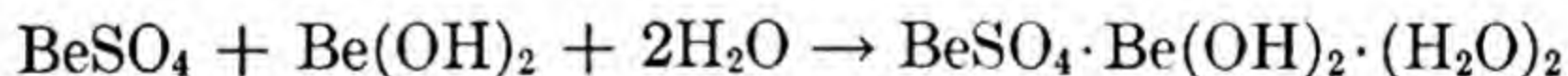
A. Atterberg, K. Sv. Vet. Akad. Handl. Öfvers., **30**, No. 4, 83 (1873)

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I-2563

When beryllium hydroxide is added to a neutral solution of beryllium sulfate and evaporated there results a clear, glass-like mass of dihydrated basic beryllium sulfate.



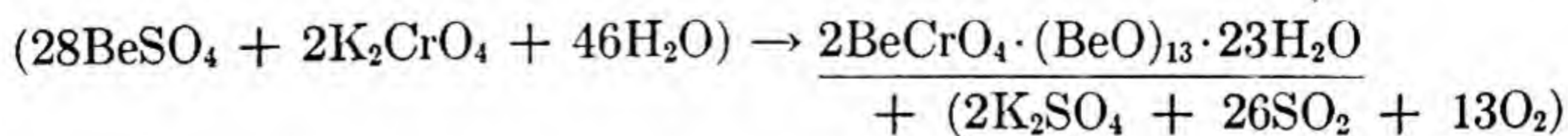
A. Atterberg, K. Sv. Vet. Akad. Handl. Öfvers., **30**, No. 4, 81 (1873)

10



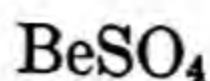
I-2564

Potassium chromate solution added carefully to an excess of beryllium sulfate solution yields a pale yellow precipitate of hydrated basic beryllium chromate, probably with complicated side reactions.



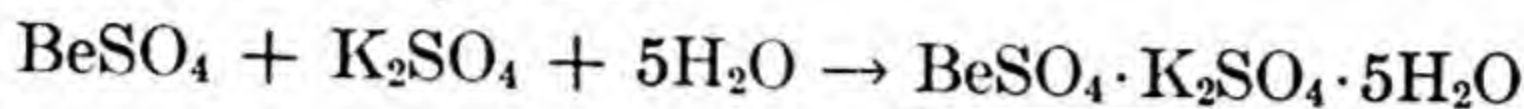
A. Atterberg, K. Sv. Vet. Akad. Handl. Öfvers., **30**, No. 4, 83 (1873)

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I-2565

A solution containing equivalent quantities of beryllium sulfate and potassium sulfate is evaporated.



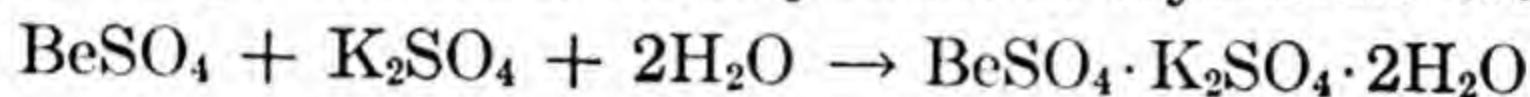
G. Marchal, *J. Chim. phys.*, **22**, 325 (1925)

25



I-2566

When solutions of beryllium sulfate and of potassium sulfate are mixed and allowed to evaporate, the dihydrated double sulfate of beryllium and potassium separates as a white powder or crystalline crusts.

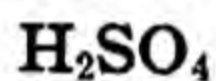


A. Atterberg, *K. Sv. Vet. Akad. Handl. Öfvers.*, **30**, No. 4, 82 (1873)

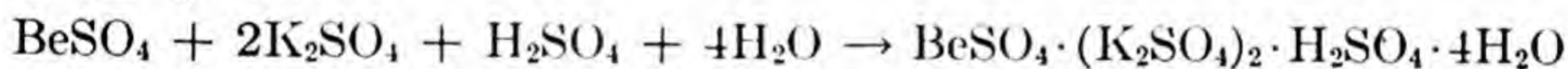
10



I-2567



When sulfuric acid is added to a concentrated solution of beryllium sulfate and potassium sulfate there precipitates tetrahydrated beryllium potassium hydrogen sulfate. Evaporation of a more dilute solution yields the acid salt as rounded clusters of tightly packed, small, needle prisms.



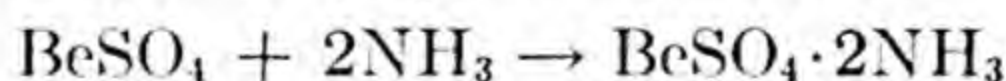
A. Atterberg, *K. Sv. Vet. Akad. Handl. Öfvers.*, **30**, No. 4, 82 (1873)

10



I-2568

Dry ammonia is passed over beryllium sulfate at -17 to -21° .



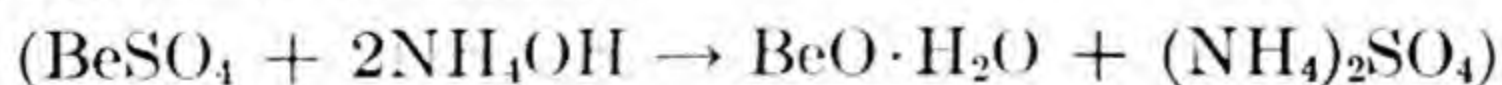
Fritz Ephraim, *Ber.*, **59**, B 1219 (1926)

25



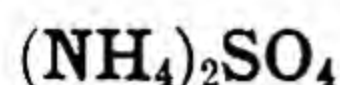
I-2569

Hydrated beryllium oxide is precipitated from a solution of the sulfate by a slight excess of ammonia:



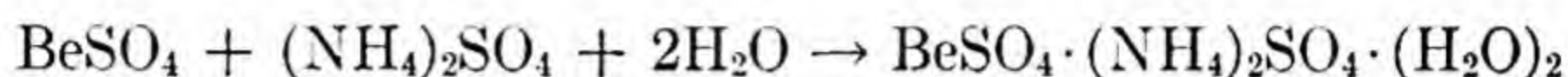
G. Marchal, *J. Chim. phys.*, **22**, 325 (1925)

69



I-2570

A solution containing equivalent weights of beryllium sulfate and ammonium sulfate, evaporated first by heat and then over sulfuric acid to a thick syrup, forms transparent crystals of the hydrated double salt.



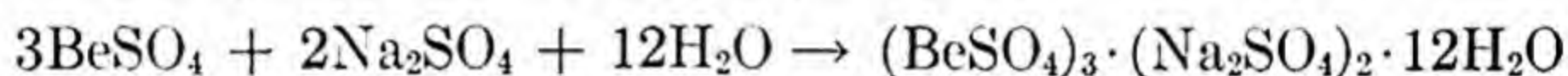
A. Atterberg, K. Sv. Vet. Akad. Handl., **12**, 26 (1873)

10



I-2571

When a neutral solution of three equivalents of beryllium sulfate and two equivalents of sodium sulfate is evaporated to a syrupy consistency star-like groups of fine needle crystals of the hydrated double sulfate of beryllium and sodium separate.



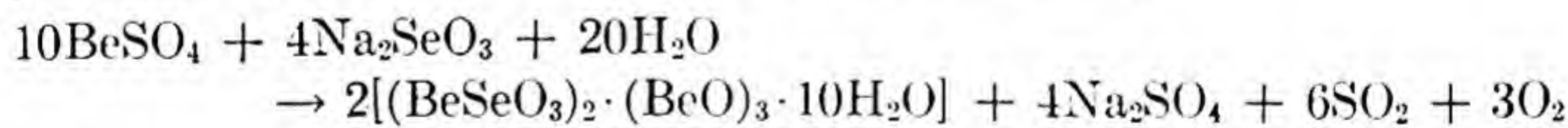
A. Atterberg, K. Sv. Vet. Akad. Handl., **12**, 26 (1873)

10



I-2572

When solutions of beryllium sulfate and sodium selenite are mixed a number of basic or acid beryllium selenites are formed according to conditions. The 2:3:10 hydrated basic beryllium selenite becomes a permanent precipitate in an excess of sodium selenite.



L. F. Nilson, Nova Acta Reg. Soc. Sci. Upsal. [3], Vol. **9**, No. 7, 47 (1874)

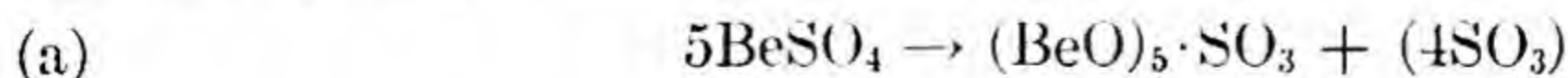
10



Δ

I-2573

The decomposition of beryllium sulfate at 700°C. gives a basic salt (a). The complete decomposition (b) takes place at a much higher temperature and is slow.



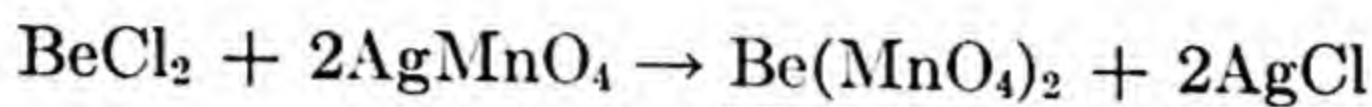
G. Marchal, J. Chim. phys., **22**, 493 (1925)

69

AgMnO₄

I-2574

Solutions of beryllium chloride and silver permanganate are mixed and the filtrate concentrated.



Moles and Crespi, *Anales soc. Espan fis. quim.*, **21**, 305 (1923)

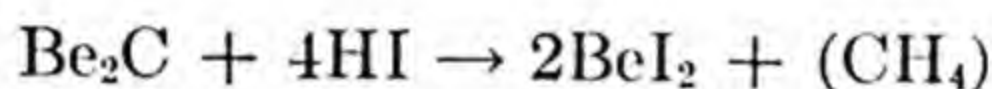
25



HI

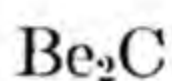
I-2575

Finely divided beryllium carbide is heated to redness in a stream of hydriodic acid.



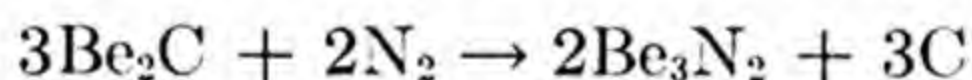
Lebeau, *Compt. rend.*, **126**, 1272 (1898)

25

N₂

I-2576

Beryllium carbide is heated to 1250° in an atmosphere of nitrogen.



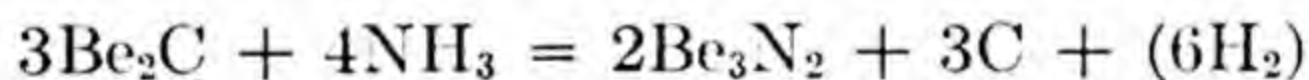
F. Fichter and E. Brunner, *Z. anorg. chem.*, **93**, 84 (1915)

25

NH₃

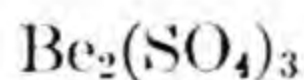
I-2577

Beryllium carbide is heated to 1000° in an atmosphere of ammonia.



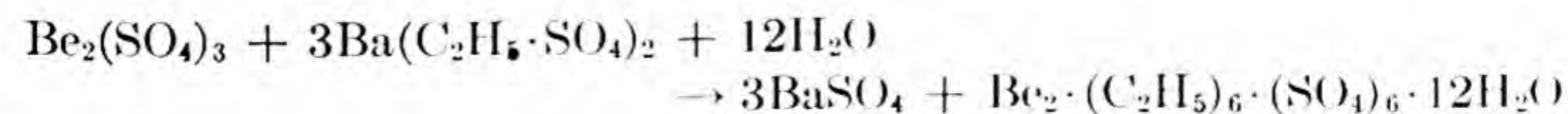
F. Fichter and E. Brunner, *Z. anorg. Chem.*, **93**, 84 (1915)

25

Ba(C₂H₅·SO₄)₂

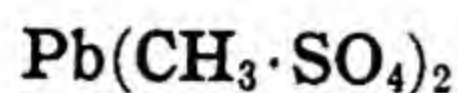
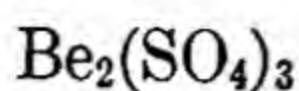
I-2578

Solutions of beryllium sulfate and barium ethyl sulfate are mixed and the barium sulfate filtered off. The filtrate yields deliquescent tablets of dodeca-hydrated beryllium ethyl sulfate.



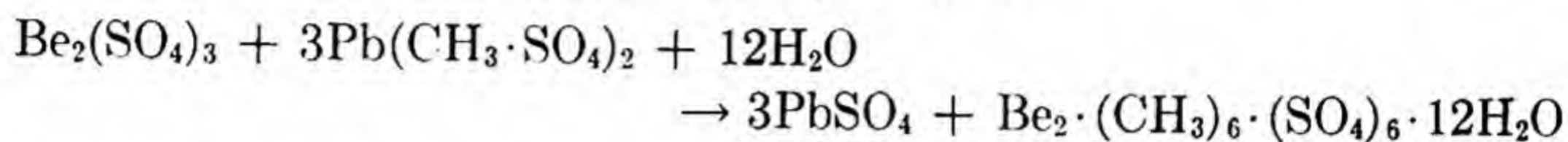
J. E. Alèn, *K. Sv. Vet. Akad. Handl. Öfvers.*, **37**, No. 8, 39 (1880)

10



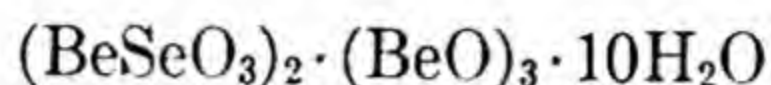
I-2579

Solutions of beryllium sulfate and lead methyl sulfate are mixed, the lead sulfate filtered off, and the filtrate yields flat, deliquescent prisms of dodeca-hydrated beryllium methyl sulfate.



J. E. Alèn, K. Sv. Vet. Akad. Handl. Öfvers., **37**, No. 8, 17 (1880)

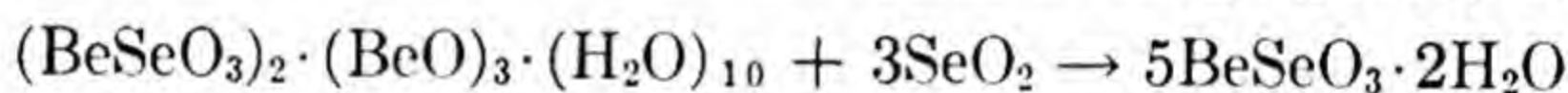
10



I-2580

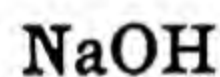
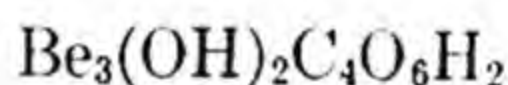


When the 2:3:10 hydrated basic beryllium selenite is treated with selenium dioxide, water added, and the mixture evaporated at 60° the dihydrated normal beryllium selenite forms as tough gummy masses.



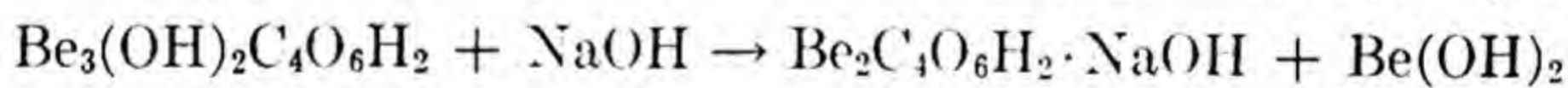
L. F. Nilson, Nova Acta Reg. Soc. Sci. Upsal. [3], Vol. **9**, No. 7, 48 (1874)

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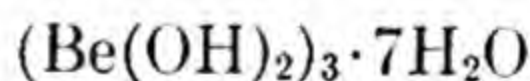
I-2581

When sodium hydroxide is added to a solution of basic beryllium tartrate, a complex is formed in solution and the hydroxide is precipitated.



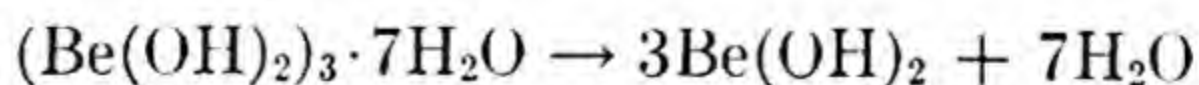
J. L. Delsal, J. Chim. phys., **35**, 314 (1938)

69



I-2582

Precipitated beryllium hydroxide when dried or heated to 100° forms anhydrous beryllium hydroxide.



A. Atterberg, K. Sv. Vet. Akad. Handl., **12**, 12 (1873)

10

BISMUTH

Bi

BiCl₃**I-2583**

Bismuth and bismuth trichloride are fused in stoichiometric proportions to yield a black mass of bismuth dichloride.

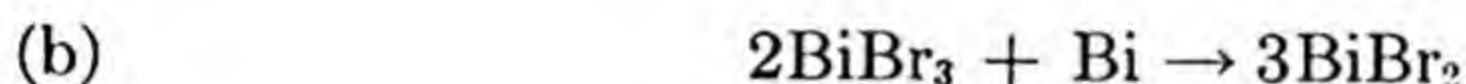
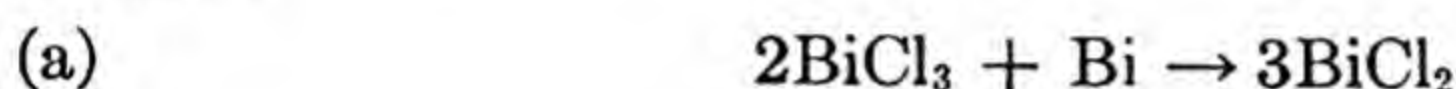


G. P. Luchinsky and A. T. Likhacheva, *J. Gen. Chem. (USSR)*, **6**, 1452 (1936) 60

Bi

BiCl₃**I-2584****BiBr₃****BiI₃**

Bismuthous chloride is formed when bismuth trichloride is heated with bismuth. Bismuthous bromide and iodide are prepared in an analogous manner.



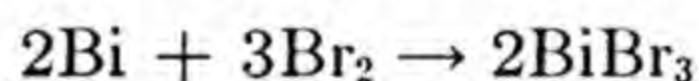
W. Herz and A. Guttmann, *Z. anorg. Chem.*, **56**, 422 (1908)

Ref.: G. Senter, *J. Chem. Soc. (London)*, **94**, 199 (1908) 57

Bi

Br₂**I-2585**

Bismuth tribromide is obtained when bismuth is heated in bromine.



R. Gerstl, *Ber.*, **9**, 76 (1876) 26

Bi

Cl₂**I-2586**

A current of dry chlorine passed over bismuth in a retort heated to the point of fusion reacts to form black bismuth dichloride. Deherain, on the basis of other reactions, thinks the formula should be doubled.



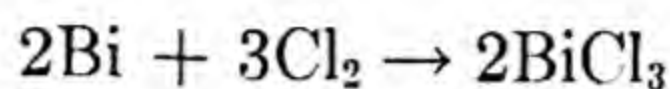
Deherain, *Compt. Rend.*, **54**, 724 (1862) 29

Bi

Cl₂

I-2587

If a stream of chlorine gas is passed over heated bismuth, beautiful crystals of bismuth trichloride are formed. These are then sublimed in a stream of carbon dioxide.



R. Gerstl, *Ber.*, **9**, 75 (1876)

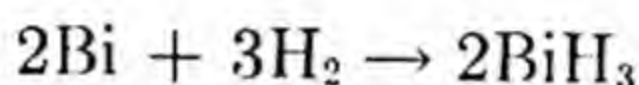
26

Bi

H₂

I-2588

The preparation of the gaseous hydride is made possible by using the Bredig method of making sparks between metal electrodes under the liquid surface. A strong electrolyte and frequent sparks permit the formation of the hydride.



F. Paneth, *Z. Elektrochem.*, **26**, 452 (1920)

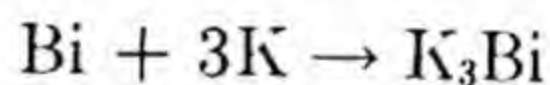
86

Bi

K

I-2589

Bismuth reacts with potassium metal confined under boiling paraffin.



Vournasos, *Compt. Rend.*, **152**, 714 (1911)

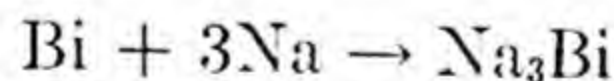
25

Bi

Na

I-2590

Bismuth reacts with sodium metal confined under boiling paraffin.



Vournasos, *Compt. Rend.*, **152**, 714 (1911)

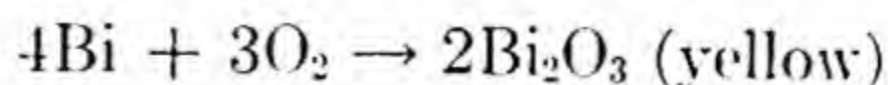
25

Bi

O₂

I-2591

Bismuth is heated to redness in air or oxygen.



Thomson, *Proc. Glasgow Phil. Soc.*, **42**, 4 (1841)

25

Bi

O₂

I-2592

HCl

Bismuth dissolves in hydrochloric acid in the presence of air or oxygen.



Ditte and Metzner, *Compt. Rend.*, **115**, 1303 (1892)

25

Bi

S

I-2593

When a mixture of bismuth and sulfur is heated in a sealed tube the following reaction takes place at about 270°C. Even with correct proportions of the reagents the combination is never complete.



H. Pélabon, *J. Chim. phys.*, **2**, 321 (1904)

69

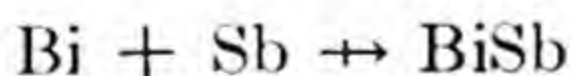
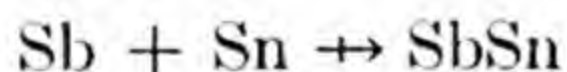
Bi

Sn

I-2594

Pb

Freezing point studies show that no compounds are formed in alloy systems of the three metals, bismuth-lead-tin. This contradicts the conclusions of others (e.g. Reinders, *Zeit. anorg. Chem.*, **25**, 113 (1900)) based on studies of densities and other physical properties of these systems.



etc.

E. S. Shepherd, *J. Phys. Chem.*, **6**, 519 (1902)

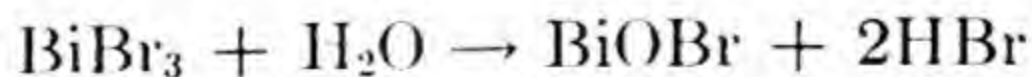
Ref., F. E. Gallagher, *J. Phys. Chem.*, **8**, 94 (1904)

7

BiBr₃H₂O

I-2595

Bismuth bromide hydrolyzes.



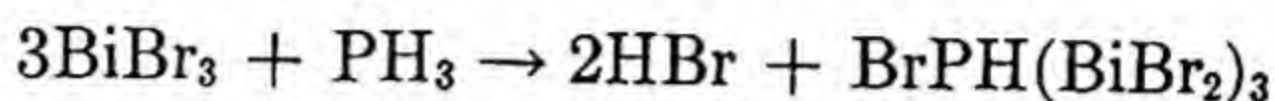
Herz and Bulla, *Z. Anorg. Chem.*, **61**, 387 (1909)

25



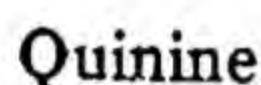
I-2596

Bismuth bromide reacts with phosphine to give hydrogen bromide, and a bromide of complex composition.



A. Cavazzi and D. Tivoli: *Gazz. Chim. Ital.* **21**², 308 (1891)

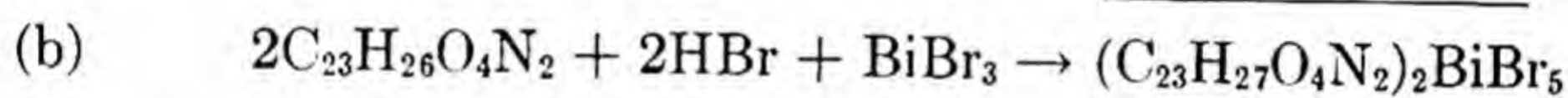
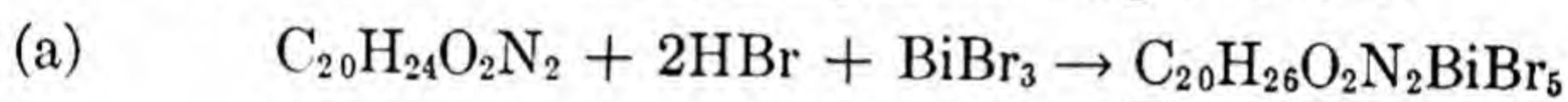
21



I-2597

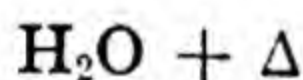
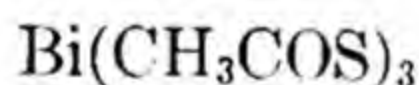


Addition of a dilute acid solution of bismuth bromide to a dilute acid solution of quinine containing an excess of potassium bromide yielded a precipitate of the quinine complex melting with gassing at 210–230°C. Similarly brucine yielded a complex melting at 273°C.



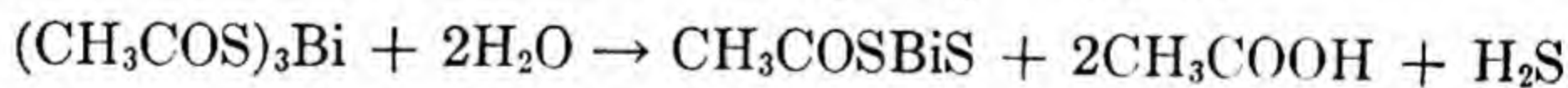
E. P. White, *J. Am. Pharm. A.*, **30**, 156 (1941)

112



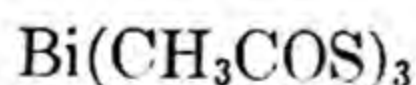
I-2598

Bismuth thioacetate in a water solution when heated gives bismuth sulfide thioacetate, acetic acid and hydrogen sulfide.



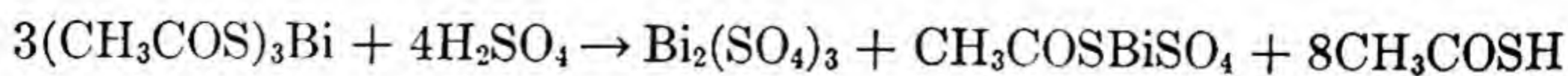
N. Tarugi: *Gazz. Chim. Ital.*, **27**¹, 320 (1897)

21



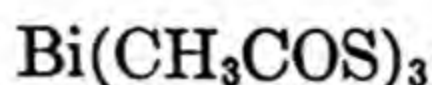
I-2599

If bismuth thioacetate and sulfuric acid are mixed and let stand in air and light the products will be bismuth sulfate, bismuth, thioacetate and thioacetic acid.



N. Tarugi: *Gazz. Chim. Ital.*, **27**¹, 321 (1897)

21

 Δ

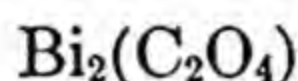
I-2600

Bismuth thioacetate is decomposed by heat to give bismuth trisulfide and acetyl sulfide.



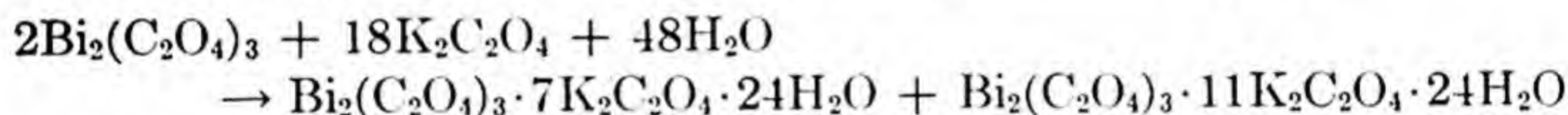
N. Tarugi: *Gazz. Chim. Ital.*, **27**¹, 322 (1897)

21

 $\text{K}_2\text{C}_2\text{O}_4$

I-2601

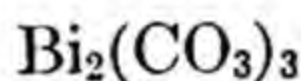
Bismuth potassium oxalate was obtained when bismuth oxalate was dissolved in hot concentrated potassium oxalate and allowed to cool. Another compound was deposited from the mother liquor.



Souchay and Lenson, *Ann.*, **105**, 245

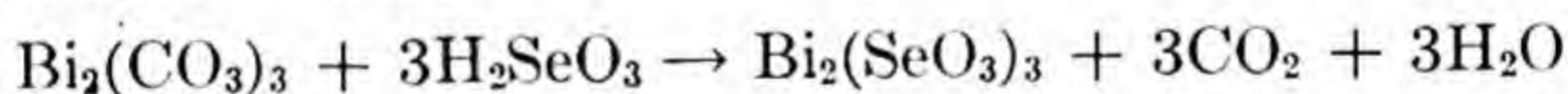
Ref., *J. Am. Chem. Soc.*, **25**, 728 (1903)

1

 H_2SeO_3

I-2602

Bismuth carbonate dissolves in selenous acid, carbon dioxide is evolved and the resulting solution yields very small needle-like crystals of anhydrous bismuth selenite.



L. F. Nilson, *K. Sv. Vet. Akad. Handl. Öfvers.*, **31**, No. 1, 42 (1874)

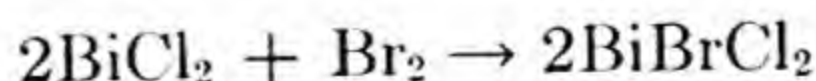
10



Br

I-2603

Bismuth dichloride is repeatedly evaporated with bromine on a water bath (70–90°), to yield almost colorless crystals of bismuth bromide dichloride.



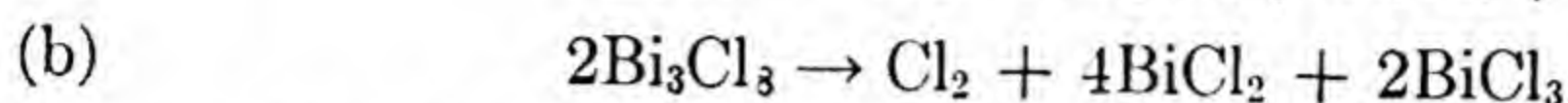
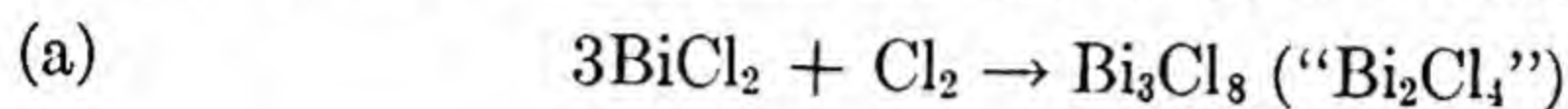
G. P. Luchinsky and A. T. Likhacheva, *J. Gen. Chem. (USSR)*, **6**, 1452 (1936)

60

Cl₂

I-2604

When black bismuth chloride is treated with chlorine, an intermediate product is first formed. Upon heating, the latter is decomposed into chlorine black bismuth chloride and bismuth trichloride.



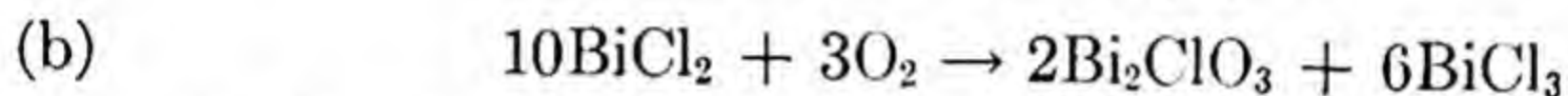
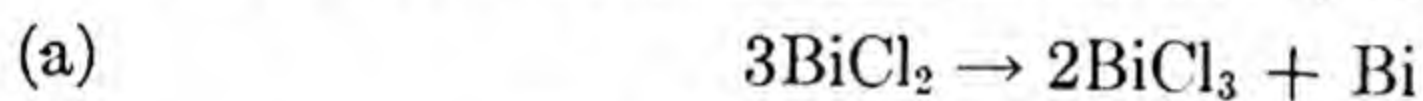
Deherain, *Compt. Rend.*, **54**, 725 (1862)

29

O₂

I-2605

When black bismuth chloride is heated in air, bismuth trichloride and bismuth are obtained, and in addition an oxychloride is formed.



Deherain, *Compt. Rend.*, **54**, 725 (1862)

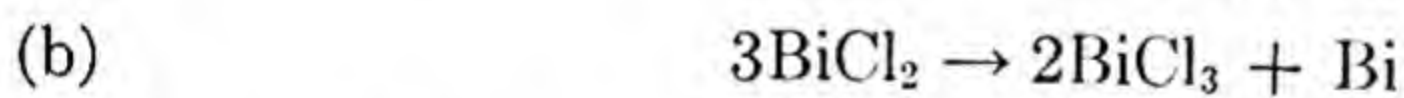
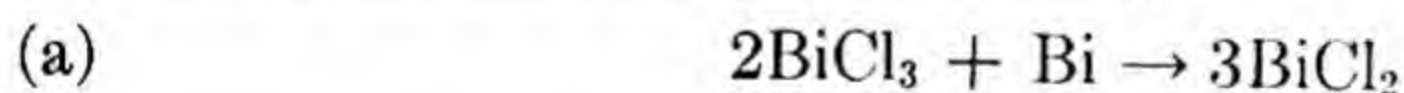
29



Bi

I-2606

Hot BiCl₃ solution dissolves granulated bismuth. Bismuth crystals separate from the solution on cooling.



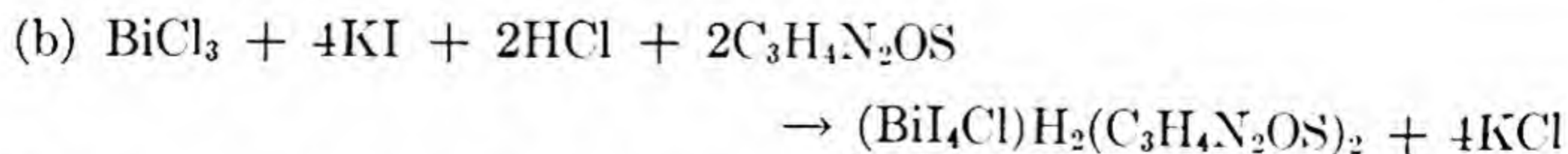
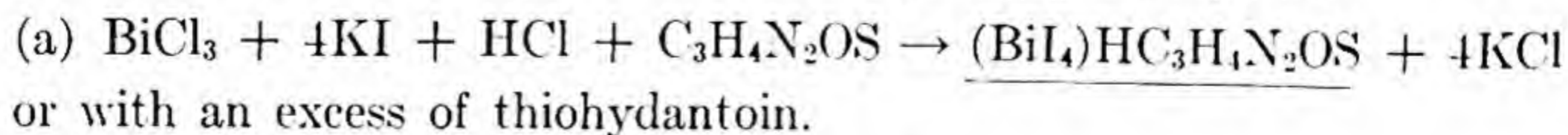
H. G. Denham: *J. Chem. Soc.*, (London), **93**, 835 (1908)

57

C₃H₄N₂OS

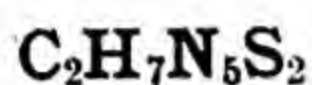
I-2607

Bismuth chloride reacts with pseudothiohydantoin in presence of potassium iodide and hydrochloric acid, yielding red crystals.



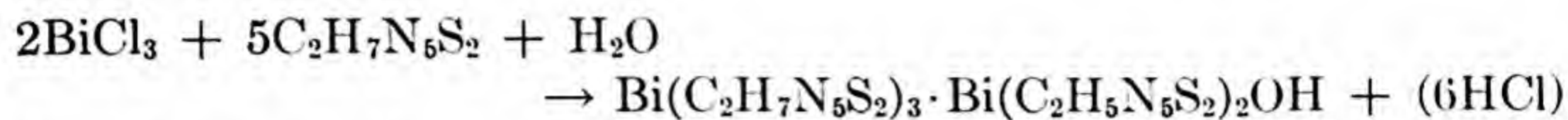
I. V. Dubsky, V. Lindelar and V. Cernak, *Mikrochem.*, **25**, 124 (1938)

28

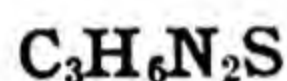


I-2608

Bismuth chloride will react with dithiourazol yielding a precipitate of orange-red color.

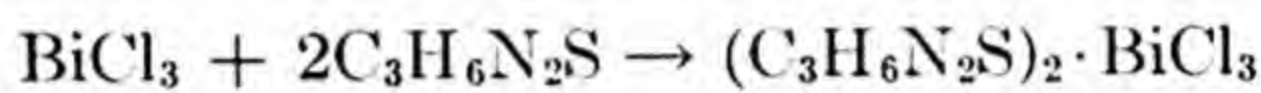


J. V. Dubsky, A. Okac and J. Trtilek, Z. anal. Chem., **100**, 412 (1935) 28

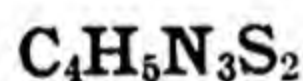


I-2609

Bismuth chloride will react with ethylene sulfocarbamide yielding a yellow precipitate.

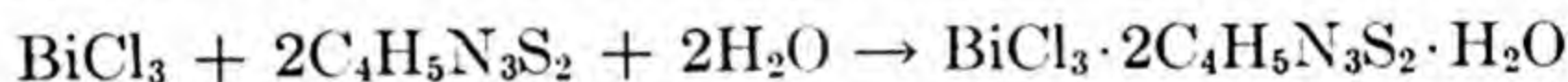


J. V. Dubsky, A. Okac B. Okac and J. Trtilek, Z. anal. Chem., **98**, 189 (1934) 28



I-2610

Bismuth chloride will react with chryseane yielding a yellow precipitate.

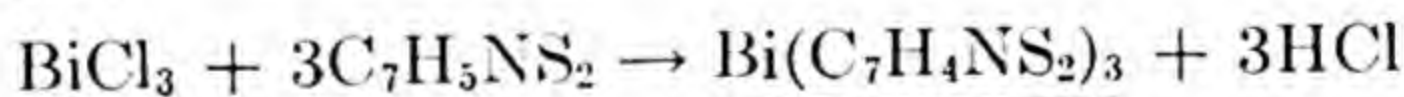


J. V. Dubsky, A. Okac B. Okac and J. Trtilek, Z. anal. Chem., **98**, 189 (1934) 28

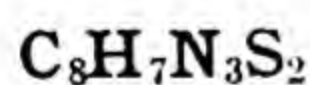


I-2611

Bismuth chloride will react with mercaptobenzothiazole yielding a yellow precipitate.

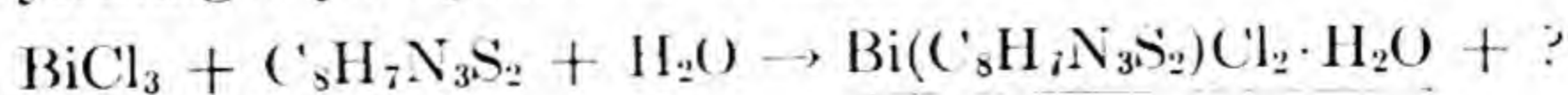


G. Spacu and M. Kuras, Z. anal. Chem., **104**, 88 (1936) 28

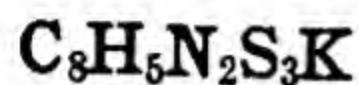


I-2612

Bismuth chloride will react with an alcoholic solution of dithiophenylurazol yielding a precipitate of orange color.

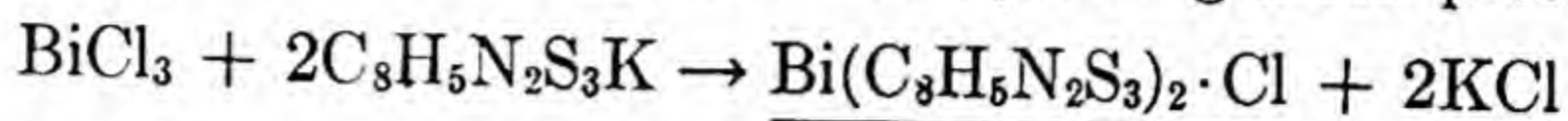


J. V. Dubsky, A. Okac and J. Trtilek, Z. anal. Chem., **100**, 412 (1935) 28



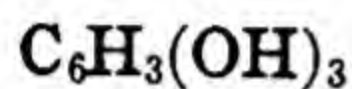
I-2613

Bismuth chloride will react with the potassium salt of phenyl dithio diazolon sulfhydrate dissolved in alcohol yielding a red precipitate.

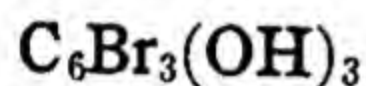


Dubsky and Trtilek, Z. anal. Chem., **96**, 414 (1934)

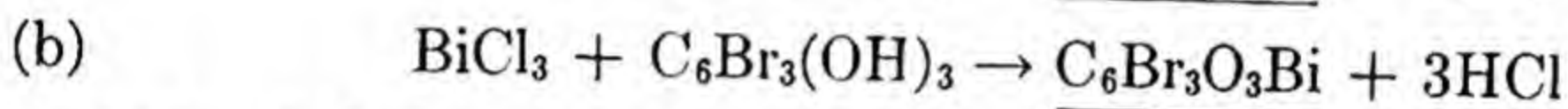
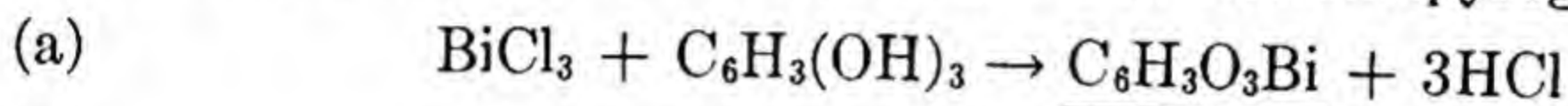
28



I-2614

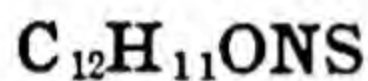


Bismuth trichloride will react with pyrogallol yielding a yellow precipitate. The same type reaction occurs with tribromopyrogallol.



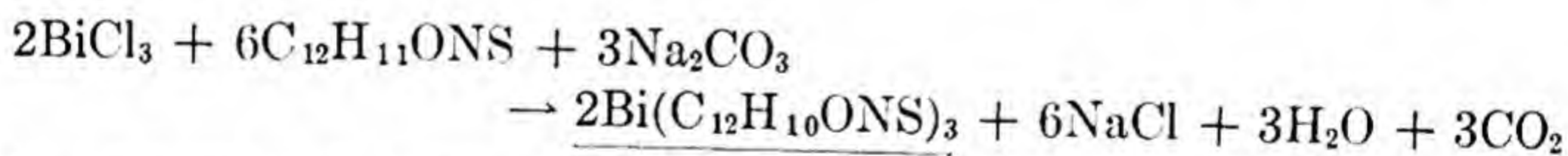
F. Feigl and H. Ordelt, Z. Anal. Chem., **65**, 448 (1924)

28



I-2615

Bismuth chloride will react with a 2% alcoholic solution of thioglycolic acid β-aminonaphthalide (Thionalide), yielding a precipitate of yellow color.



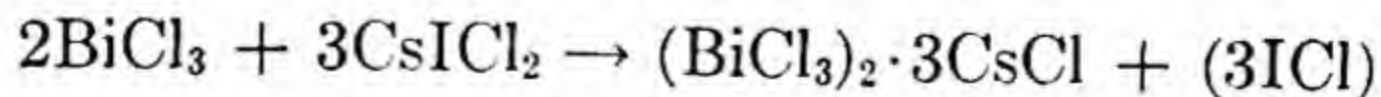
R. Berg and E. S. Fahrenkamp, Z. anal. Chem., **112**, 161 (1938)

28



I-2616

A yellow crystalline salt, a double compound of bismuth chloride and cesium chloride, is obtained when the perhalide of cesium was dissolved in water and a molecular quantity of bismuth trichloride added and chlorine passed through the hot solution.



Brigham, Am. Chem. J., **14**, 181 (1892)

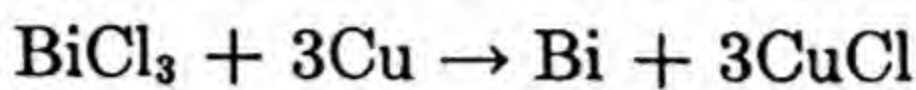
Ref., Hutchins and Lenher, J. Am. Chem. Soc., **29**, 33 (1907)

1



Cu **I-2617**

Metallic copper will reduce a solution of bismuth chloride to bismuth.

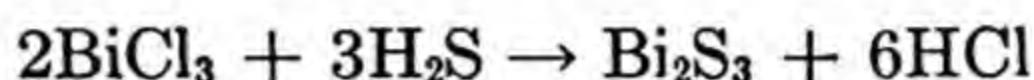


G. G. Reissaus, *Z. anal. Chem.*, **70**, 303 (1927) 28



H₂S **I-2618**

Hydrogen sulfide reacts with bismuth trichloride at bright red heat.



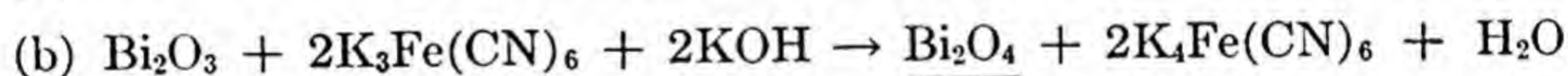
Muir and Eagles, *J. Chem. Soc. (London)*, **67**, 90 (1895) 25



K₃Fe(CN)₆ **I-2619**

KOH

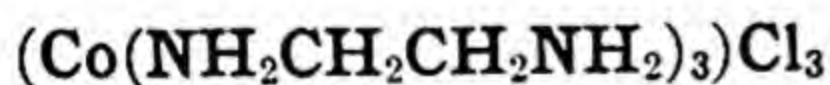
Bismuth trioxide, prepared from a bismuth salt, like the trichloride, will be oxidized to bismuth tetroxide by heating with an alkaline solution of potassium ferric cyanide. The bismuth tetroxide is purified by heating with 15% nitric acid to boiling until it turns yellow.



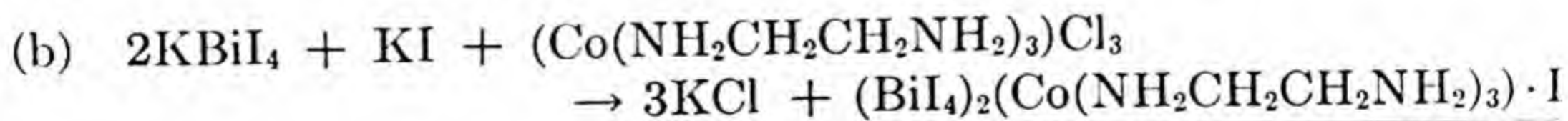
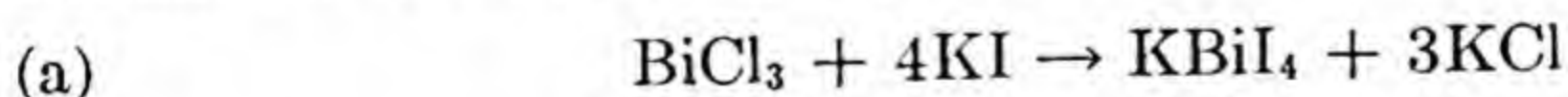
O. Hauser and L. Vanino, *Z. anorg. Chem.*, **39**, 381 (1904) 28



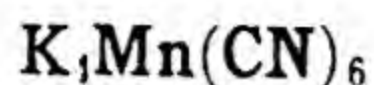
KI **I-2620**



Bismuth chloride will react with potassium iodide and cobalt diethylene-diamine chloride, yielding a yellow precipitate.

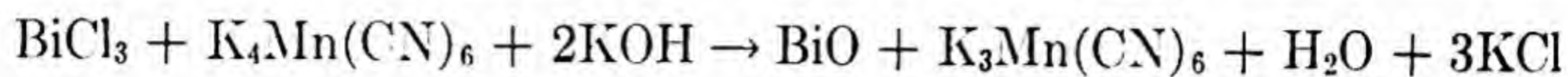


Spacu and Suciu, *Z. anal. Chem.*, **79**, 196 (1930) 28



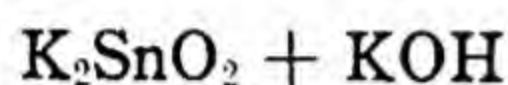
I-2621

Bismuth chloride will react with potassium manganese cyanide in presence of potassium hydroxide yielding a black precipitate.



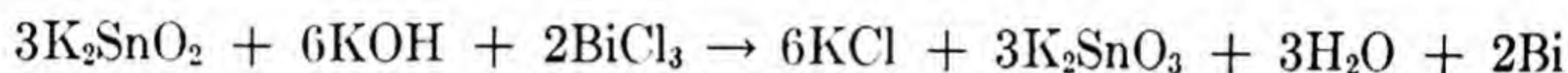
N. A. Trananaeff, *Z. anal. Chem.*, **105**, 420 (1936)

28



I-2622

An excess of a hot solution of potassium stannite is added to bismuth trichloride solution in the presence of potassium hydroxide.



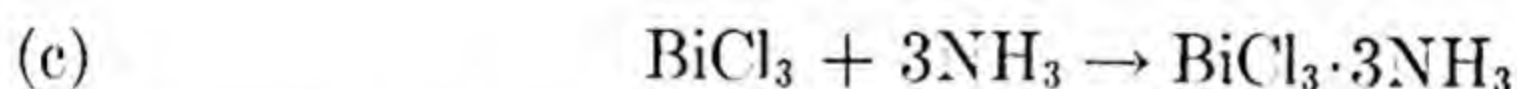
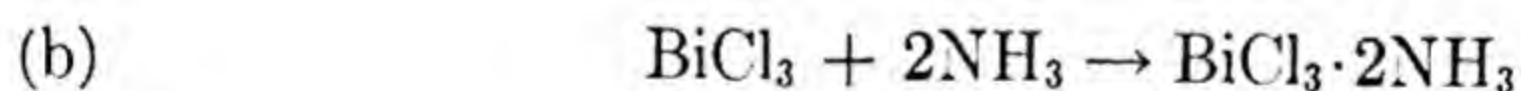
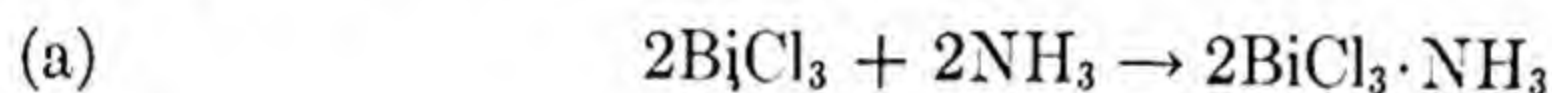
Vanino and Treubert, *Ber.*, **31**, 1113 (1898)

25



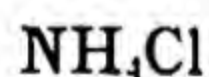
I-2623

Bismuth trichloride warmed slightly in a retort reacts with dry ammonia gas to form three ammoniates.



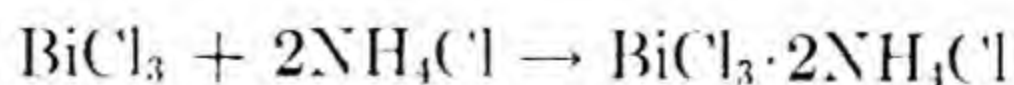
Deherain, *Compt. Rend.*, **54**, 726 (1862)

29



I-2624

Colorless crystals of the double compound of bismuth chloride and ammonium chloride are formed when solid ammonium chloride is added to a hydrochloric acid solution of bismuth trichloride which is saturated with chlorine at -10° .



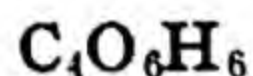
Deherain, *Compt. rend.*, **54**, 726 (1862)

Ref., Hutchins and Lenher, *J. Am. Chem. Soc.*, **29**, 33 (1907)

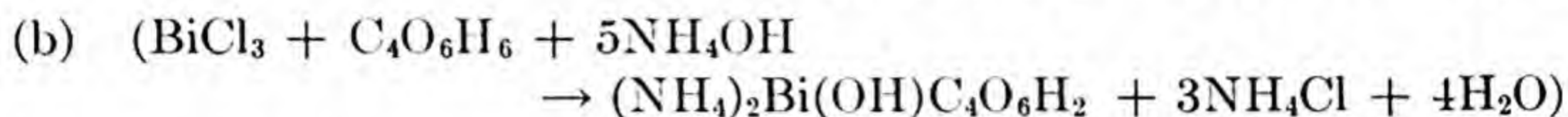
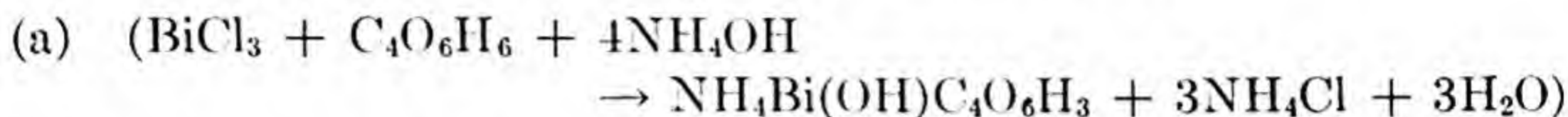
1



I-2625

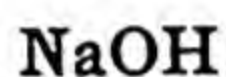


Two complexes are formed in solution in the neutralization of a mixture of bismuth chloride and tartaric acid with ammonia:



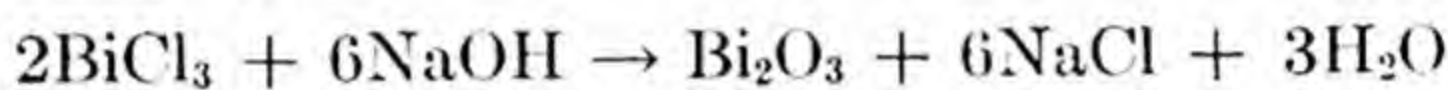
J. L. Delsal, *J. chim. phys.*, **35**, 350 (1938)

69



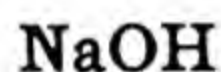
I-2626

A boiling solution of bismuth trichloride is precipitated with a slight excess of sodium hydroxide.

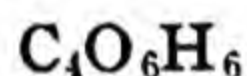


Picon, *J. pharm. chim.*, (S) **3**, 58 (1926)

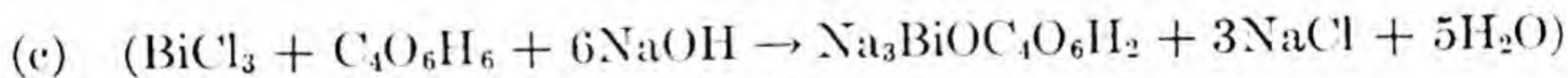
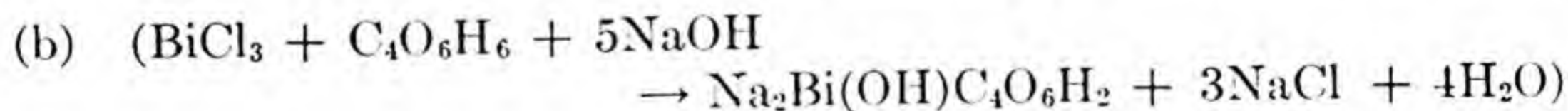
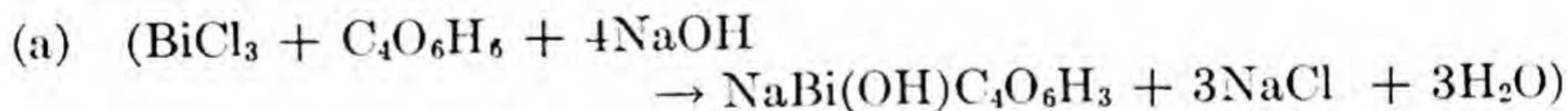
25



I-2627



The polarimetric neutralization of solutions of bismuth chloride and tartaric acid with potassium or sodium hydroxide reveals the existence of three complexes:



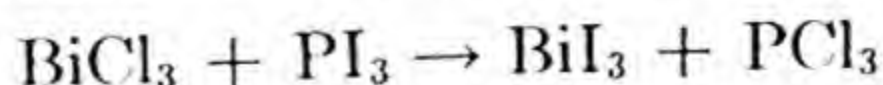
J. L. Delsal, *J. Chim. phys.*, **35**, 350 (1938)

69



I-2628

Bismuth trichloride reacts with phosphorus triiodide.



Karantassis, *Compt. Rend.*, **182**, 1391 (1926)

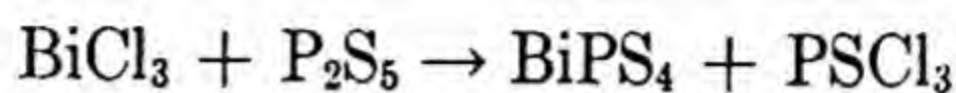
25



P_2S_5

I-2629

Bismuth thiophosphate of black color is obtained when a mixture of bismuth chloride and phosphorus pentasulfide is heated.



E. Glatzel, *Z. anorg. Chem.*, **4**, 186 (1893)

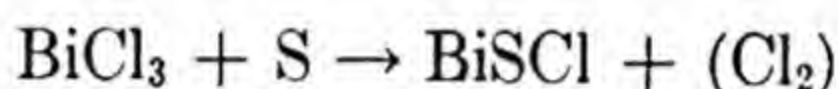
28



S

I-2630

The compound bismuth thiochloride is obtained when bismuth trichloride is fused with sulfur.



Muir, *J. Chem. Soc. (London)*, **39**, 22 (1881)

Ref., Hutchins and Lenher, *J. Am. Chem. Soc.*, **29**, 32 (1907)

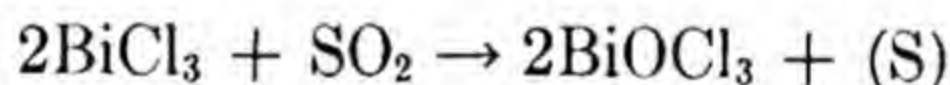
1



SO_2

I-2631

Bismuth trichloride is slightly attacked by sulfur dioxide under the influence of heat.



M. P. Muir, *J. Chem. Soc. (London)*, **33**, 193 (1878)

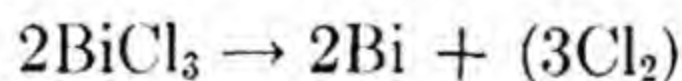
91



ε

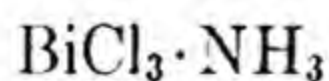
I-2632

A black spongy deposit of metal is produced by electrolysis of a solution of bismuth trichloride in methyl alcohol.



L. Kahlenberg, *J. Phys. Chem.*, **4**, 349 (1900)

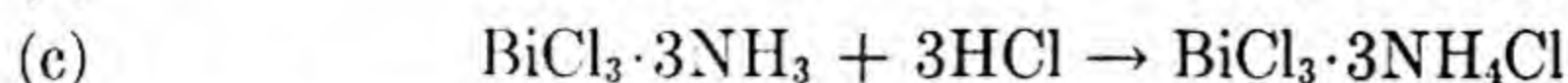
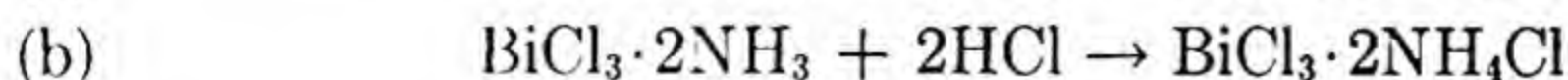
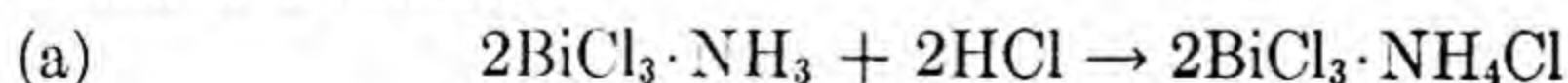
7



HCl

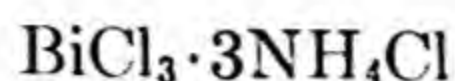
I-2633

Hydrochloric acid forms addition products with the ammoniates of bismuth trichloride.

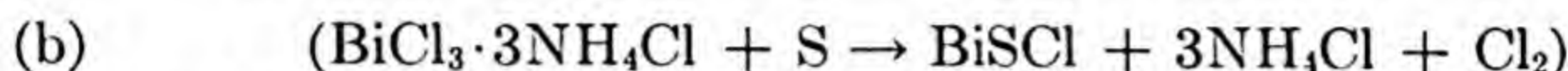
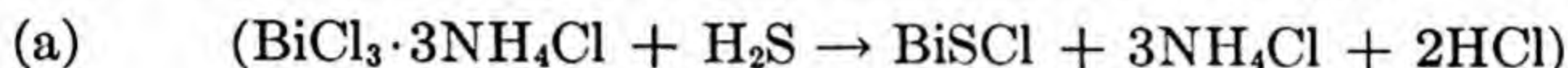


Deherain, *Compt. Rend.*, **54**, 726 (1862)

29

**H₂S****I-2634****S**

By passing hydrogen sulfide over the double compound bismuth chloride ammonium chloride it was found that the substance bismuth thiochloride is obtained. The reactants must be kept hot during this reaction. The same compound may be formed by heating with sulfur.



Muir and Eagles, J. Chem. Soc. (London), **67**, 90 (1895)

103

**Δ****I-2635****ε**

A high frequency discharge in the vapor of BiF_3 gives rise to a band spectrum attributed to BiF molecules.

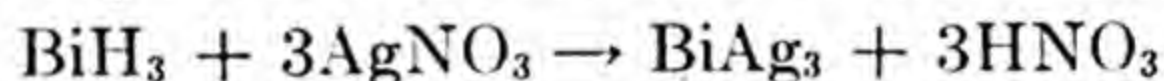


H. G. Howell, Proc. Roy. Soc. (London), **155A**, 141 (1936)

110

**AgNO₃****I-2636**

Bismuth hydride is passed into a solution of silver nitrate.

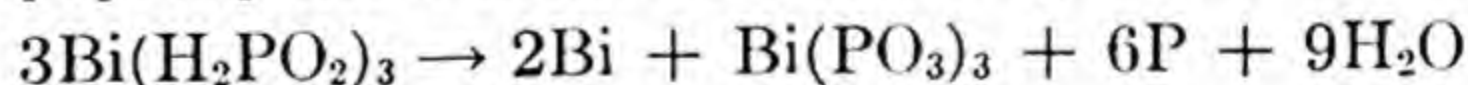


Weeks and Druce, Nature, **116**, 710 (1925)

25

**Δ****I-2637**

Bismuth hypophosphite is heated considerably above 100°.

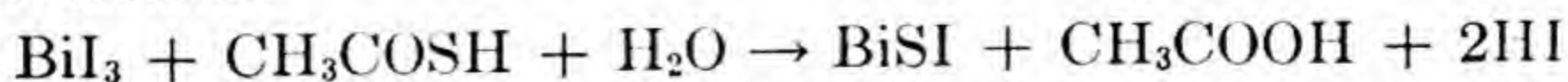


S. Hada, J. Chem. Soc. (London), **67**, 229 (1895)

25

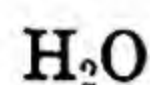
**CH₃COSH + H₂O****I-2638**

By dropping thioacetic acid a drop at a time on bismuth triiodide and cooling continuously a yellow precipitate is formed which is washed in ice cold alcohol.



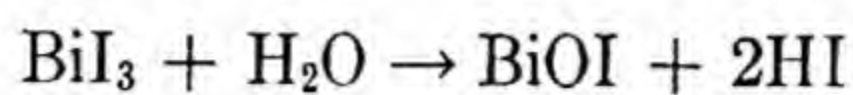
N. Tarugi: Gazz. Chim. Ital., **27**¹, 325 (1897)

21



I-2639

Bismuth triiodide is converted by cold water into red bismuthyl iodide. Warm water acts more rapidly.



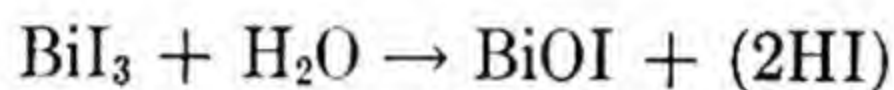
Pattison Muir, J. Chem. Soc. (London), **33**, 201 (1878)

91



I-2640

Red bismuth oxyiodide is formed when bismuth triiodide in hydriodic acid solution is poured into water at 90°–100°.



M. M. P. Muir, J. Am. Chem. Soc., **4**, 142 (1882)

Ref., E. C. Franklin, Z. anorg. Chem., **46**, 1 (1905)

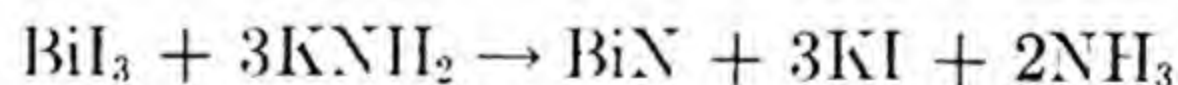
1

Bismuth



I-2641

Bismuth triiodide is dissolved in liquid ammonia and potassium amide then added. The resulting products are bismuth nitride, potassium iodide and ammonia. A similar reaction takes place with bismuth bromide.



E. C. Franklin, Z. anorg. Chem., **46**, 1 (1905)

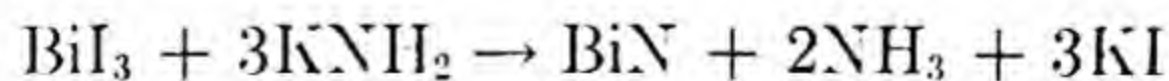
Ref., I. Schurman and W. C. Fernelius, J. Am. Chem. Soc., **52**, 2425 (1930)

25



I-2642

Bismuth nitride is formed when bismuth iodide and potassium amide are brought together in liquid ammonia solution.



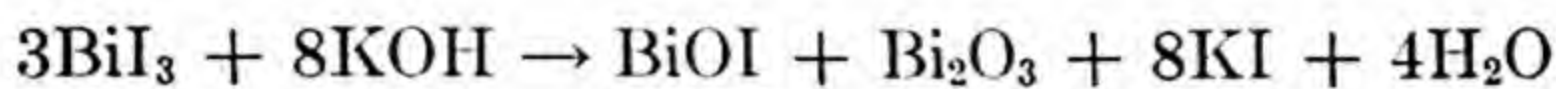
E. C. Franklin, J. Am. Chem. Soc., **27**, 848 (1905)

Ref., Schuman and Fernelius, J. Am. Chem. Soc., **53**, 2427 (1930)

1

**KOH****I-2643**

Bismuth triiodide reacts with a very dilute solution of potassium hydroxide, yielding bismuthyl iodide together with bismuth trioxide and potassium iodide.

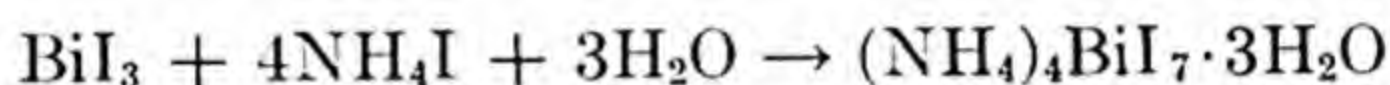


Marie-Louise Delwaulle, *Bull. soc. chim.*, **53**, 1104 (1933)

25

**NH₄I****I-2644**

By slowly evaporating a saturated solution of bismuth triiodide to which has been added a concentrated solution of ammonium iodide, reddish-brown hygroscopic crystals of ammonium heptaiodobismuthite are obtained.

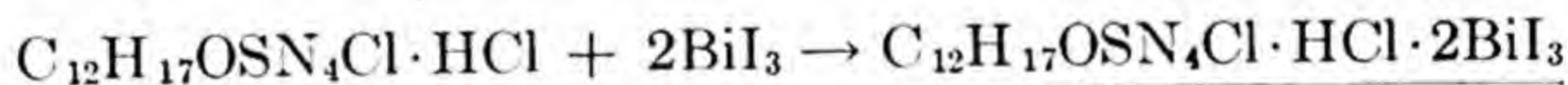


W. Linau, *Pogg. Ann.* **11**, 242 (1860)

25

**Thiamine chloride****I-2645**

The addition of a solution of bismuth triiodide to a 10% solution of thiamine chloride yields a red microcrystalline precipitate, somewhat soluble in glycols, glycerin and acetone, insoluble in ethyl acetate.

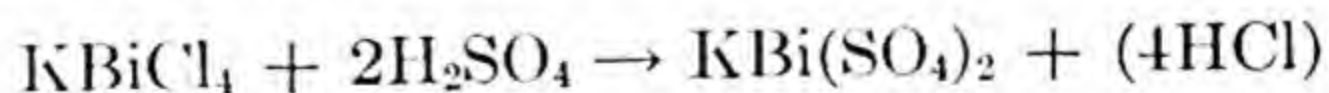


C. S. Leonard, *J. Am. Pharm. A.*, **30**, 20 (1942)

112

**H₂SO₄****I-2646**

Beautiful glistening crystals of an alum are prepared when the double chloride of bismuth is treated with concentrated sulfuric acid and heated for several hours.

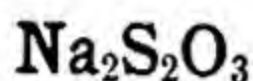


C. P. Brigham, *Am. Chem. J.*, **14**, 170 (1892)

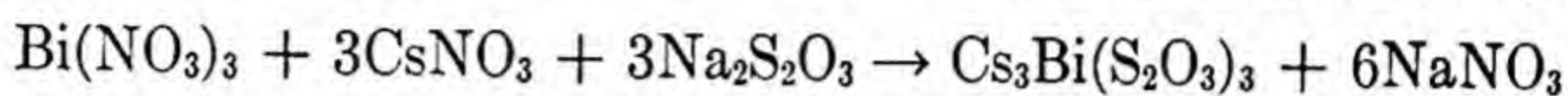
1



I-2647

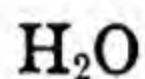


A concentrated solution of bismuth nitrate in 5% nitric acid will react with a solution of cesium nitrate and sodium thiosulfate. By adding alcohol yellow colored crystals of cesium bismuth thiosulfate are obtained.



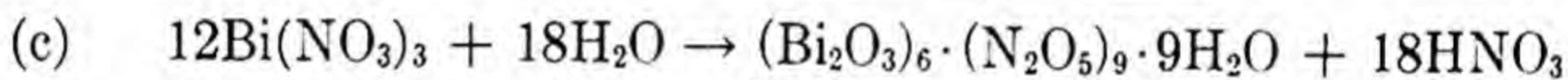
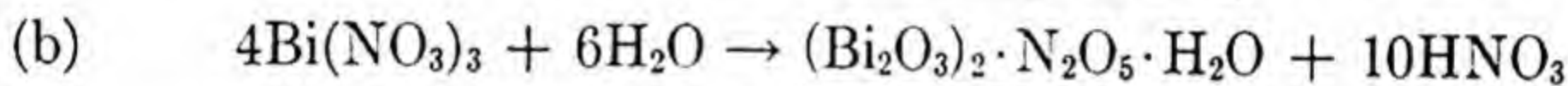
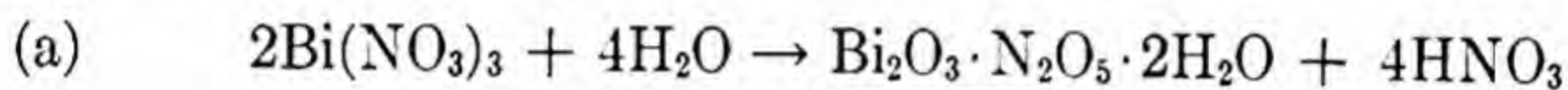
O. Hauser, *Z. anorg. Chem.*, **35**, 1 (1903)

28



I-2648

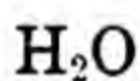
The action of water on bismuth nitrate produces several hydrolysis products. The materials of composition: $5\text{Bi}_2\text{O}_3 \cdot 4\text{N}_2\text{O}_5 \cdot 9\text{H}_2\text{O}$, and $11\text{Bi}_2\text{O}_3 \cdot 9\text{N}_2\text{O}_5 \cdot 21\text{H}_2\text{O}$ which appear in the literature as definite compounds are found to be mixtures.



F. B. Allan, *Am. Chem. J.*, **25**, 307 (1901)

Ref., Miller and Kenrick, *J. Phys. Chem.*, **7**, 259 (1903)

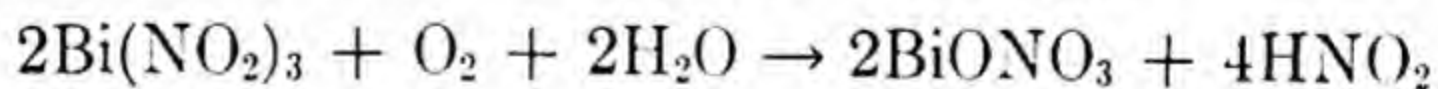
7



I-2649



If bismuth nitrite is exposed to the action of water and oxygen it may react to yield bismuth subnitrate and nitrous acid.



W. C. Ball, *J. Chem. Soc. (London)*, **97**, 1410 (1910)

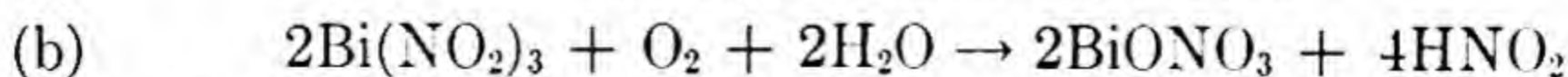
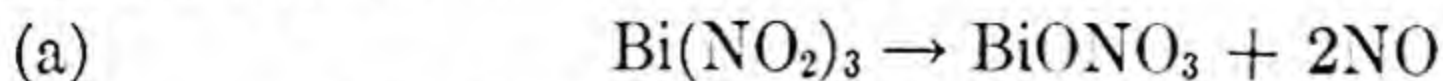
103



I-2650



When bismuth nitrite solutions are exposed to air a scum of bismuthyl nitrate appears on the surface.



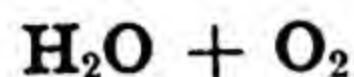
W. C. Ball, *J. Chem. Soc. (London)*, **97**, 1410 (1910)

57

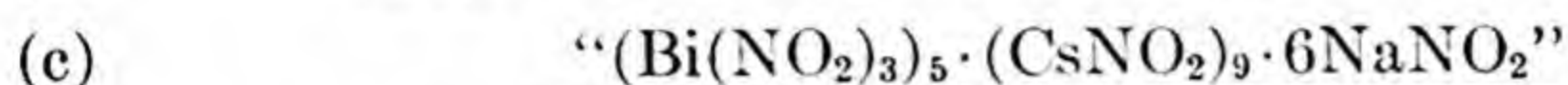
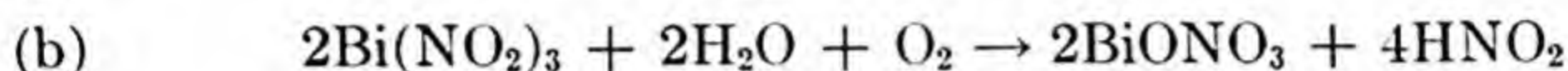
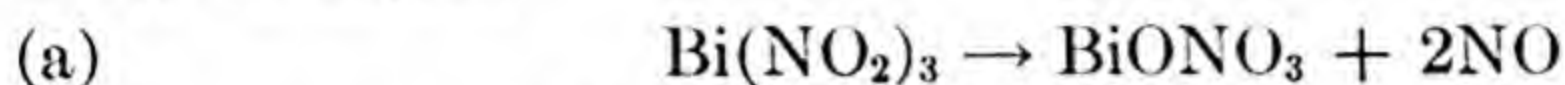


Decomp.

I-2651

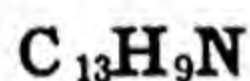


Bismuth nitrite decomposes slowly at room temperature (a). It reacts with water and oxygen to yield a subnitrate (b); and in combination with potassium and cesium nitrites will precipitate sodium quantitatively as in (c).



W. C. Ball, J. Chem. Soc. (London), **97**, Pt. 2, 1410 (1910)

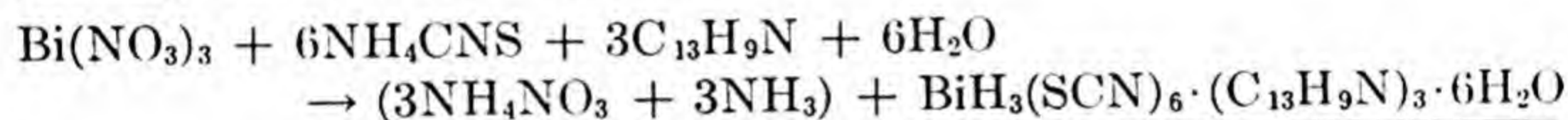
25



I-2652



Bismuth nitrate reacts with ammonium thiocyanate and acridine, yielding characteristic crystals.



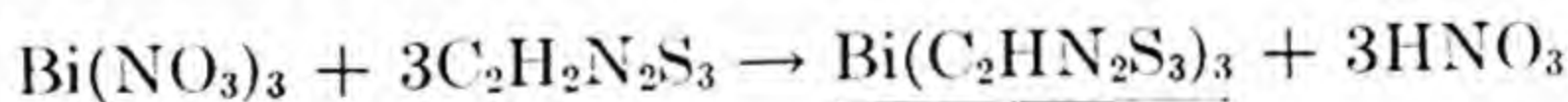
A. Langer, Mikrochem., **25**, 71 (1938)

28



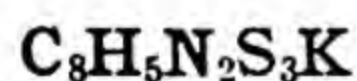
I-2653

Bismuth nitrate will react with a solution of dimercaptodiazole in potassium hydroxide yielding a red precipitate.



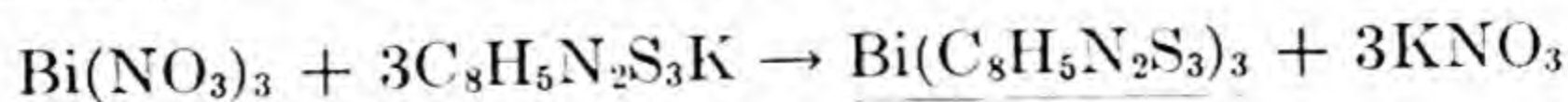
Dubsky and Okac, Z. anal. Chem., **96**, 269 (1934)

28



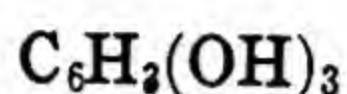
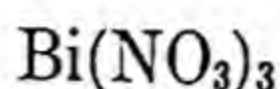
I-2654

Bismuth nitrate will react with the potassium salt of phenyl dithiodiazolon sulfhydrate yielding a red precipitate.

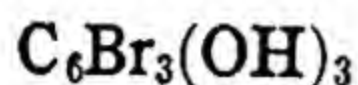


Dubsky and Trtilek, Z. anal. Chem., **96**, 414 (1934)

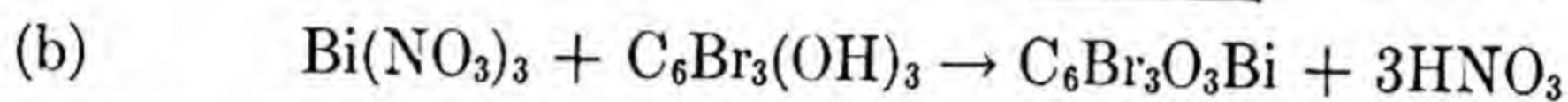
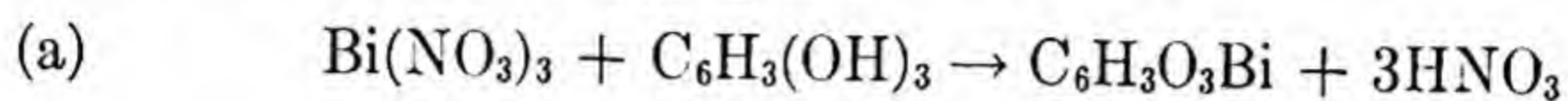
28



I-2655

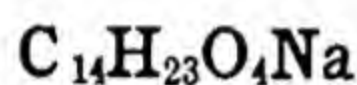


Bismuth nitrate reacts with pyrogallol in presence of nitric acid, yielding characteristic crystals of yellow color. The same type reaction occurs with tribromo pyrogallol.



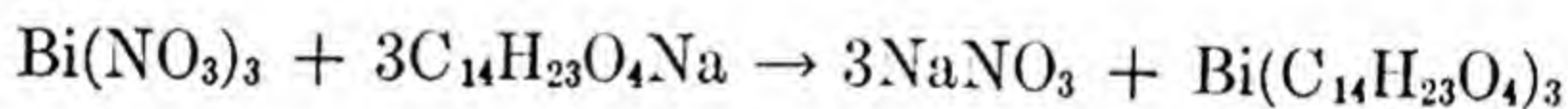
F. Feigl and H. Ordelt, *Mikrochem.*, **2**, 187 (1924)

28



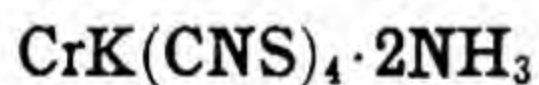
I-2656

Bismuth nitrate, dissolved in 50% glycerin and water, was added to a solution of sodium menthyl-succinate in dilute alcohol. The semi-solid precipitate of bismuth menthyl-succinate was washed by decantation, extracted with ether and dried. 85.5% of the heavy yellow viscous material was obtained and found to be soluble in ethanol, acetone and olive oil.



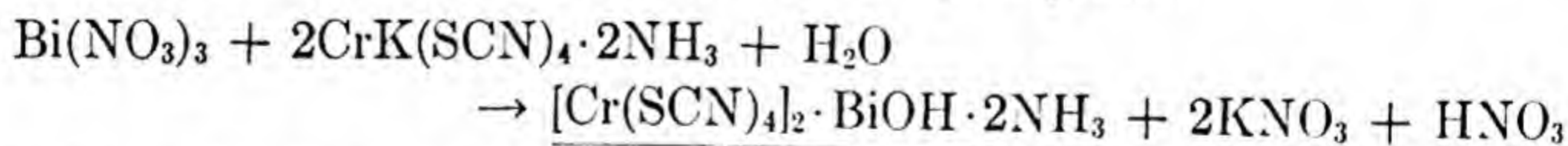
Lauter and Vrla, *J. Am. Pharm. A.*, **27**, 753 (1938)

112



I-2657

Bismuth nitrate will react with chromic potassium thiocyanate diammoniate (Reinecke salt) yielding a yellow precipitate.



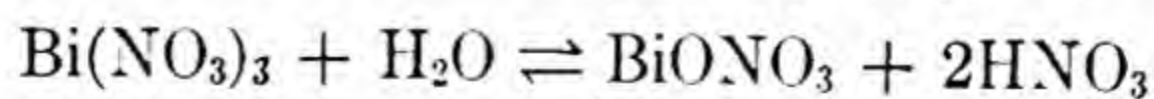
J. V. Dubsky, A. Okac B. Okac and J. Trtilek, *Z. anal. Chem.*, **98**, 189 (1934)

28



I-2658

In slightly acid solution, bismuth nitrate hydrolyzes after the reaction:

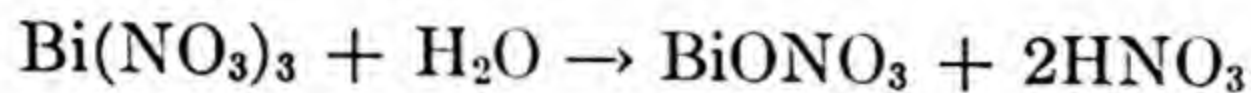


F. Joliot, *J. Chim. phys.*, **27**, 119 (1930)

69

H₂O**I-2659**

Bismuth nitrate hydrolyzes when treated with water giving basic bismuth nitrate and nitric acid.

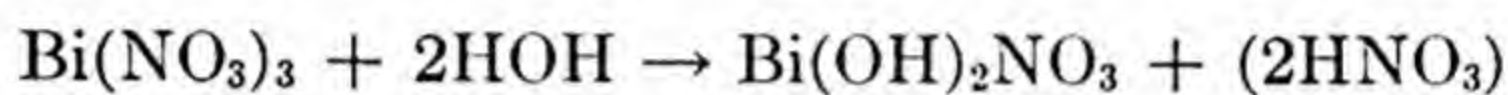


C. Kullgren, Sv. Kem. Tidskr., **13**, 108 (1901)

10

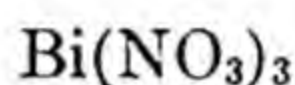
H₂O**I-2660**

Bismuth oxynitrate is precipitated when a nitric acid solution of bismuth nitrate is treated with water.

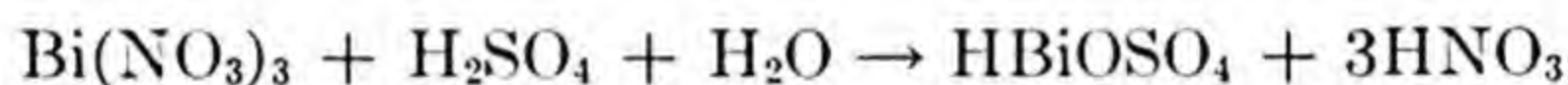


E. A. Atkinson, J. Am. Chem. Soc., **20**, 802 (1898)

1

H₂SO₄**I-2661**

A nitric acid solution of bismuth nitrate reacts with sulfuric acid.

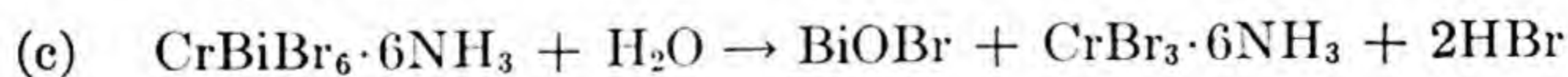
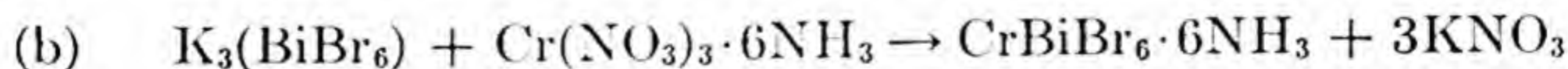
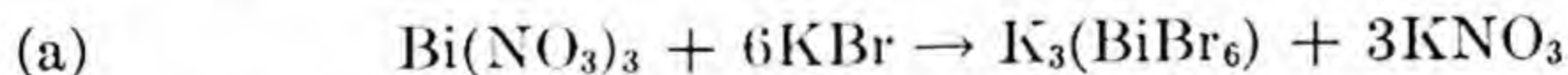


Heintz and Ruge, J. Prakt. Chem., **96**, 138 (1865)

25

KBr**I-2662****Cr(NO₃)₃·6NH₃**

Bismuth nitrate will react with potassium bromide forming complex anions. These in turn will react with chromium nitrate hexammoniate yielding a crystalline precipitate of yellow color which will be hydrolyzed by water.



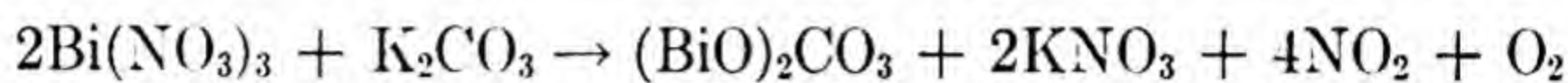
Mahr, Z. anal. Chem., **93**, 435 (1933)

28



I-2663

Bismuthyl carbonate is formed when potassium carbonate is added to bismuth nitrate dissolved in a strong solution of mannitol.



Vanino and Zumbusch, Ber., **41**, 3994-9 (1908)

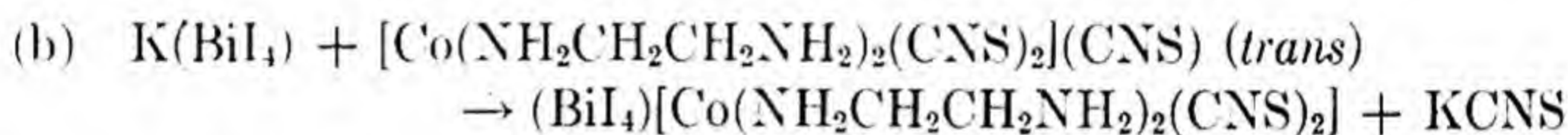
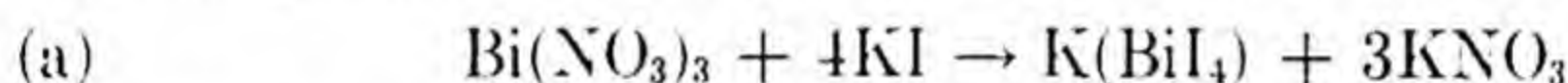
25



I-2664

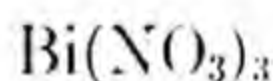


Bismuth nitrate will form a complex salt with potassium iodide. This in turn will react with a concentrated solution of the above complex cobalt salt yielding a crystalline precipitate of yellow color.



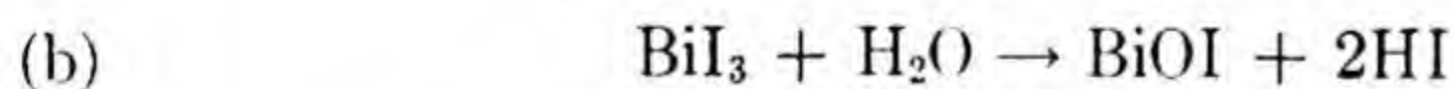
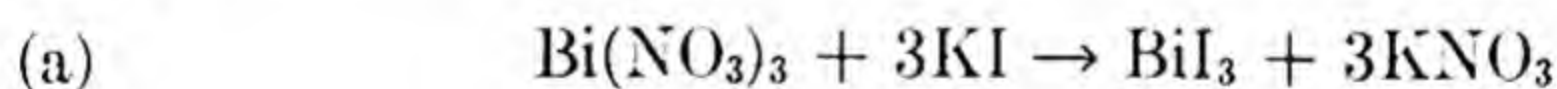
Spacu and Spacu, Z. anal. Chem., **93**, 260 (1933)

28



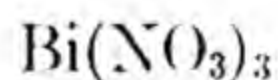
I-2665

Bismuth nitrate reacts with potassium iodide, forming a black precipitate. Dilution with water and heating to 55°-80° yields a red precipitate.

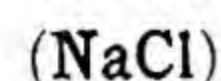


R. Strebinger and W. Zins, Mikrochem., **5**, 168 (1927)

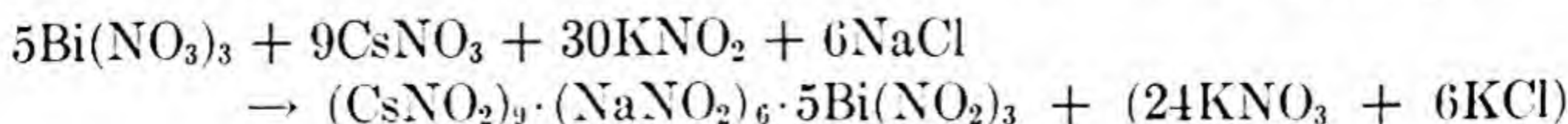
28



I-2666

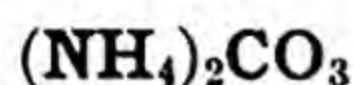


Sodium salts added to a solution of potassium nitrite containing bismuth nitrate and cesium nitrate, precipitate the following compound.



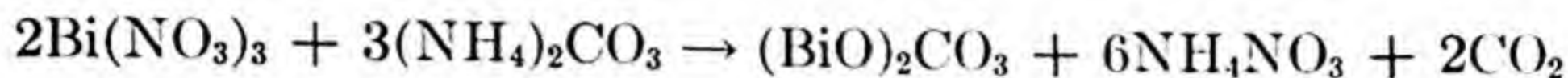
W. C. Ball, J. Chem. Soc., (London), **97**, 1408 (1910)

57



I-2667

Ammonium carbonate is added to a mannitol solution of bismuth nitrate.



Vanino and Zumbusch, Ber., **41**, 3994-9 (1908)

7



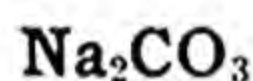
I-2668

Pure bismuth oxide is formed when the precipitate obtained by adding ammonium hydroxide and carbonate to bismuth nitrate is ignited.



J. B. Moyer, J. Am. Chem. Soc., (London), **18**, 1034 (1896)

1



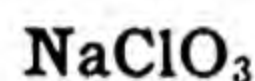
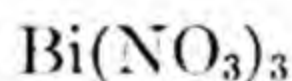
I-2669

Sodium carbonate is added to a mannitol solution of bismuth nitrate.



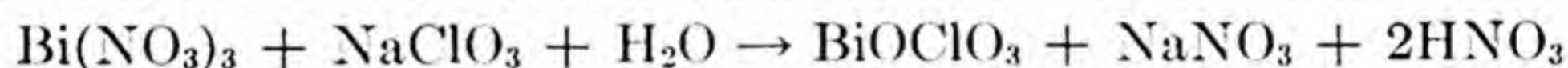
Vanino and Zumbusch, Ber., **41**, 3994-9 (1908)

7



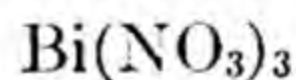
I-2670

Bismuthyl chlorate is formed when a hot concentrated solution of bismuth nitrate is treated with sodium chlorate and the solution cooled.



Vanino and Mussnug, Ber., **50**, 323 (1917)

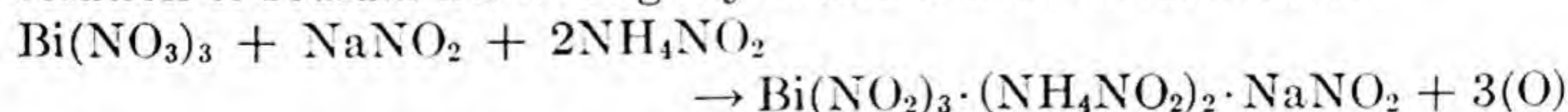
25



I-2671



Bismuth sodium ammonium nitrite can be formed by dissolving powdered bismuth nitrate in a saturated solution of ammonium nitrite at 0° and then gradually pouring this liquid into an ice-cold, nearly saturated solution of sodium nitrite slightly acidified with nitrous fumes.

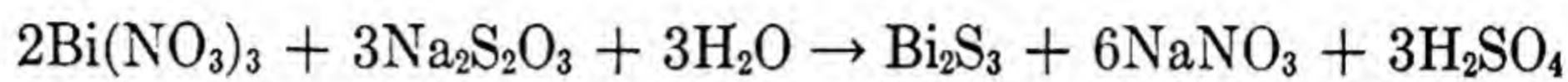


W. C. Ball, J. Chem. Soc. (London), **87**, 761 (1905)

102

Na₂S₂O₃**Bi(NO₃)₃****I-2672**

Bismuth is precipitated quantitatively from a solution of its nitrate by adding sodium thiosulfate.

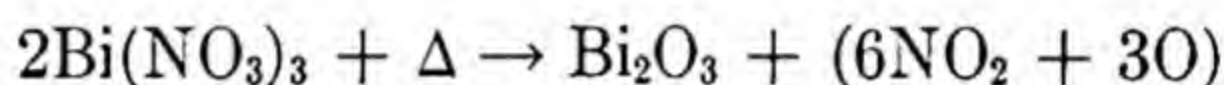


Faktor, Pharm. Post, **33**, 301

25

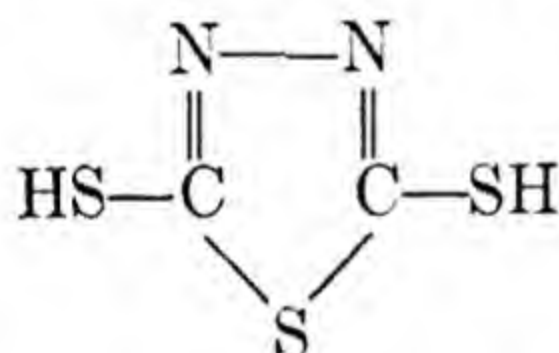
Δ**Bi(NO₃)₃****I-2673**

Bismuth nitrate is converted into the oxide when ignited.

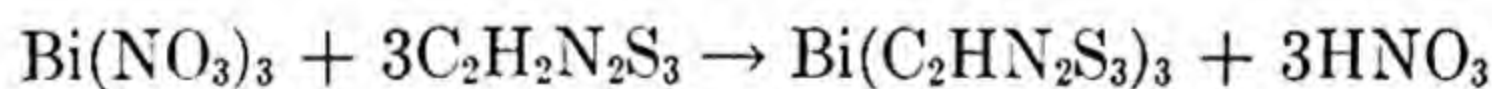


H. S. Riederer, J. Am. Chem. Soc., **25**, 908 (1903)

1

dimercapto thiadiazol**Bi(NO₃)₃****I-2674**

Dimercapto 2,5-thiadiazol gives with traces of bismuth salts in acid solution a characteristic red precipitate.



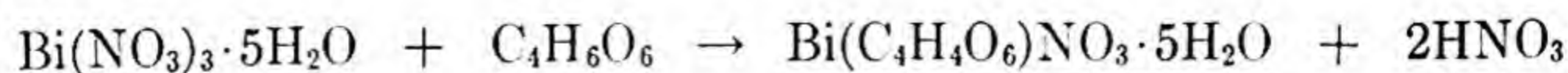
Dubský and Okáč, Chem. Ob., **9**, 3 (1934)

Ref., Dubský, et al., Chem. Ob., **9**, 171, 173 (1934)

5

C₄H₆O₆**Bi(NO₃)₃·5H₂O****I-2675**

A solution of pentahydrated bismuth nitrate will react with a solution of tartaric acid yielding colorless prismatic crystals of bismuth tartrate nitrate.



A. Rosenheim and W. Vogelsang, Z. anorg. Chem., **48**, 205 (1906)

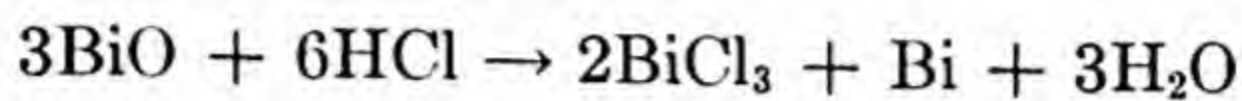
28

BiO

HCl

I-2676

Bismuth suboxide will dissolve in hydrochloric acid yielding bismuth trichloride and metallic bismuth.



S. Tanatar, Z. anorg. Chem., **27**, 437 (1901)

28

BiO

 Δ

I-2677

By heating bismuth suboxide in an atmosphere of carbon dioxide bismuth oxide and metallic bismuth are obtained.



S. Tanatar, Z. anorg. Chem., **27**, 437 (1901)

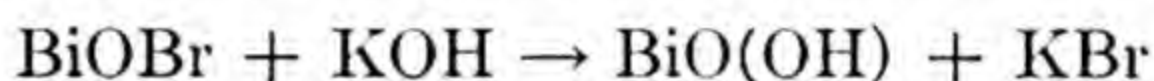
28

BiOBr

KOH

I-2678

Bismuth oxybromide is decomposed by potassium hydroxide.



W. Herz and Muhs, Z. Anorg. Chem., **39**, 115 (1904)

28

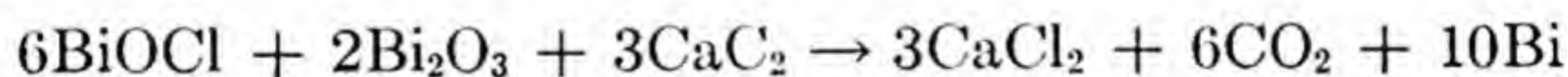
BiOCl

CaC₂

I-2679

Bi₂O₃

Bismuth oxychloride is reduced if it is heated together with calcium carbide and bismuth oxide:



F. v. Kugelgen, Z. Elektrochem., **7**, 574 (1901)

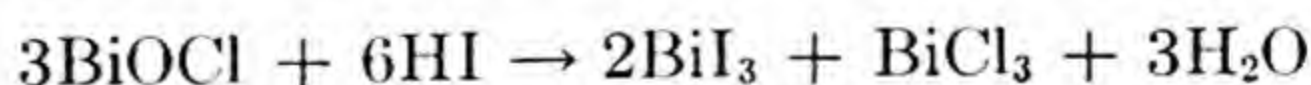
86

BiOCl

HI

I-2680

Bismuth oxychloride reacts with concentrated hydriodic acid.



Muir, J. Chem. Soc., **39**, 36 (1881)

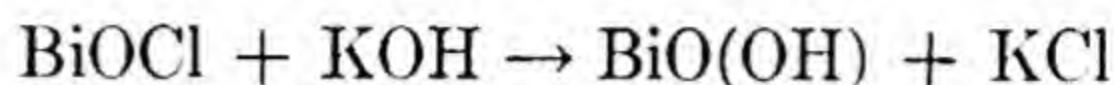
25

BiOCl

KOH

I-2681

Bismuth oxychloride reacts with dilute potassium hydroxide.



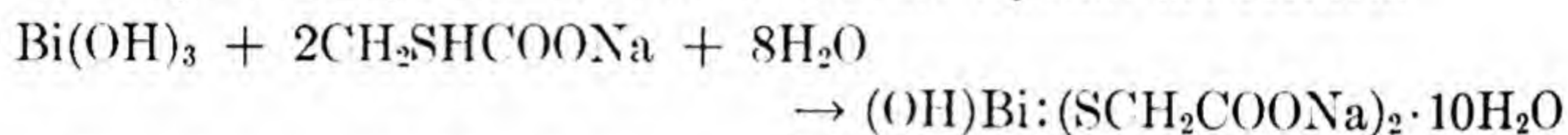
Herz and Muhs, *Z. Anorg. Chem.*, **39**, 115 (1904)

28

Bi(OH)₃CH₂SHCOONa

I-2682

A solution of sodium thioglycolate is saturated with bismuth hydroxide. On evaporation, yellow colored needle-like crystals are formed.



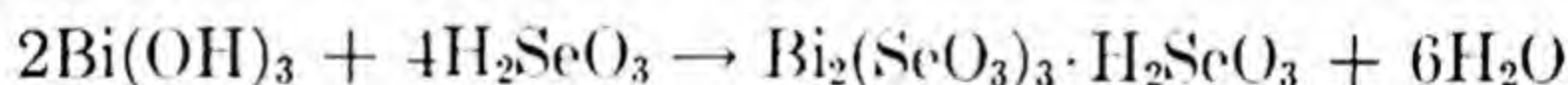
A. Rosenheim and I. Davidsohn, *Z. anorg. Chem.*, **41**, 231 (1904)

28

Bi(OH)₃H₂SeO₃

I-2683

Bismuth hydroxide, treated with excess of concentrated selenious acid at ordinary temperature, yields prismatic crystals of anhydrous bismuth hydrogen selenite.



L. F. Nilson, *Nova Acta Reg. Soc. Sci. Upsal. Series 3*, Vol. **9**, No. 7, 109 (1874)

10

Bi(OH)₃(NH₄)₂F₂

I-2684

Bismuth hydroxide will dissolve in a boiling solution of ammonium fluoride. After 24 hours colorless crystals will be formed.



H. V. Helmholt, *Z. anorg. Chem.*, **3**, 115 (1893)

28

Bi(OH)₃

Saccharic acid

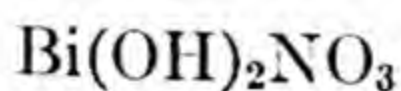
I-2685

Saccharic acid was dissolved in excess potassium hydroxide and freshly precipitated bismuth hydroxide, suspended in water, was added slowly over several hours with stirring. When all the Bi(OH)₃ had dissolved, the solution was filtered and the bismuth complex precipitated with 95% alcohol.



G. O. Doak, *J. Am. Pharm. A.*, **29**, 108 (1940)

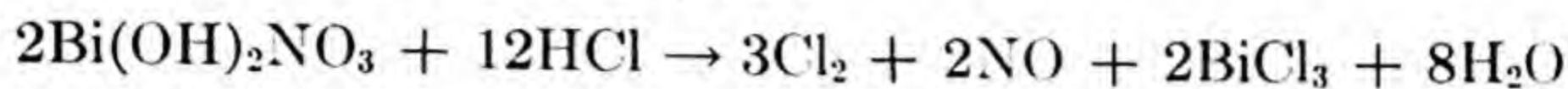
11½



HCl

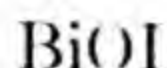
I-2686

Chlorine and nitrous oxide are obtained when basic bismuth nitrate is boiled with hydrochloric acid (2:1).



L. Moser, Z. anorg. Chem., **50**, 33 (1906)

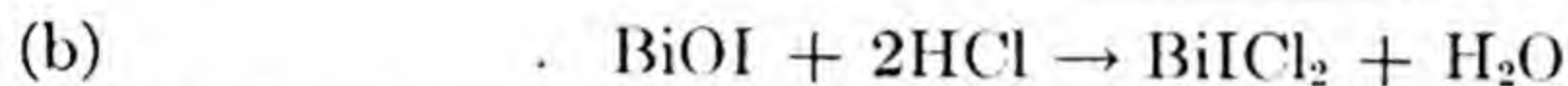
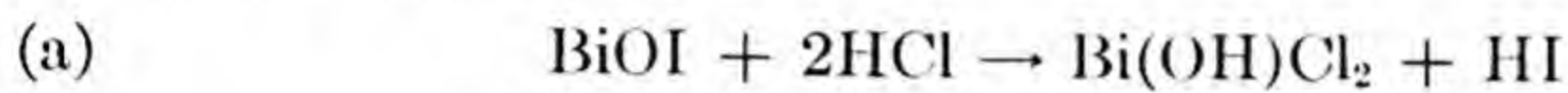
28



HCl

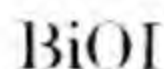
I-2687

Bismuthyl iodide in hydrochloric acid solution on dilution by H_2O yields a white precipitate of hydroxo bismuth dichloride, (a); and a brown crystalline substance (b).



G. P. Luchinsky and A. T. Likhacheva, J. Gen. Chem., (USSR), **6**, 1453 (1936)

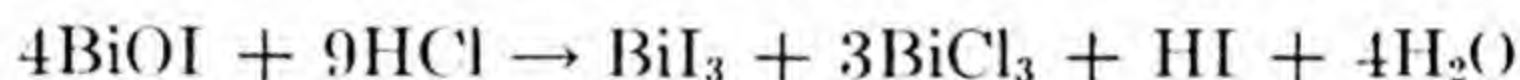
60



HCl

I-2688

Bismuth oxyiodide reacts with strong hydrochloric acid.



Muir, J. Chem. Soc., **33**, 201 (1878)

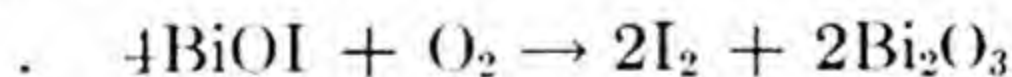
25

 O_2

I-2689

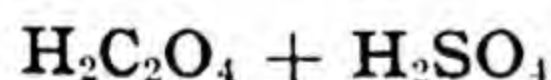
 Δ

Bismuth oxyiodide is decomposed by ignition in oxygen.



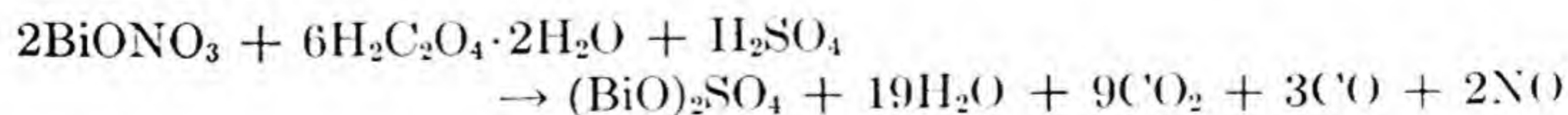
R. Strebinger and W. Zins, Mikrochem., **5**, 177 (1927)

28



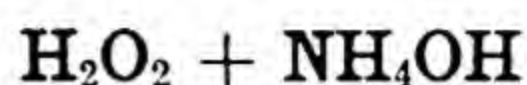
I-2690

A mixture of bismuth oxynitrate, oxalic acid and sulfuric acid is heated to $90-95^\circ$.



E. Luce, Bull. soc. chim., **23**, 264-71 (1918)

25



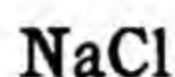
I-2691

A mixture of acidified bismuth oxynitrate and hydrogen peroxide is added in large excess to concentrated ammonium hydroxide.



Guthbier and Bunz, Chem. Zentr. I, 732 (1909)

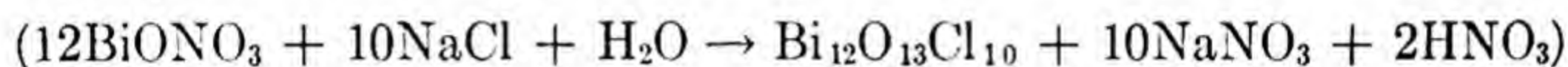
25



I-2692



Bismuth subnitrate when boiled with a solution of sodium chloride forms a complex bismuth oxychloride.



J. B. P. Harrison, Analyst, **35**, 119 (1910)

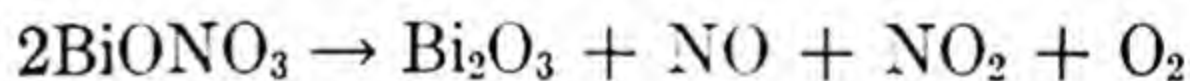
40



Δ

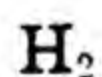
I-2693

Paste of bismuth was assayed for its bismuth subnitrate content by carefully heating in a tared crucible until melted and then igniting to constant weight. The residue of bismuth trioxide should not be less than 79% of the amount of bismuth subnitrate in the paste.



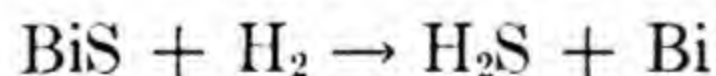
Baker and Kutzley, J. Am. Pharm. A., **29**, 324 (1940)

112



I-2694

Bismuth monosulfide is reduced by hydrogen.



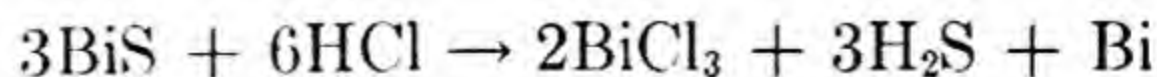
Pelabon, Compt. Rend., **132**, 78 (1901)

25



I-2695

Bismuth monosulfide reacts with hydrochloric acid.



Schneider, Pogg. Ann., **97**, 480 (1856)

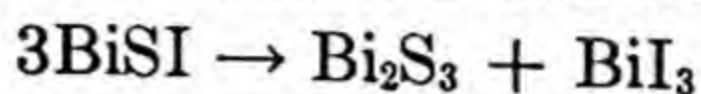
25

BiSI

Δ

I-2696

Bismuth sulfide is easily decomposed by a little heat giving bismuth iodide and leaving a black residue, bismuth sulfide.



N. Tarugi, *Gazz. Chim. Ital.*, **27**¹, 325 (1897)

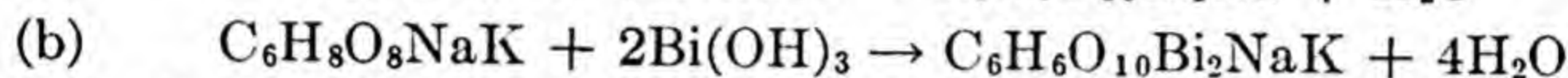
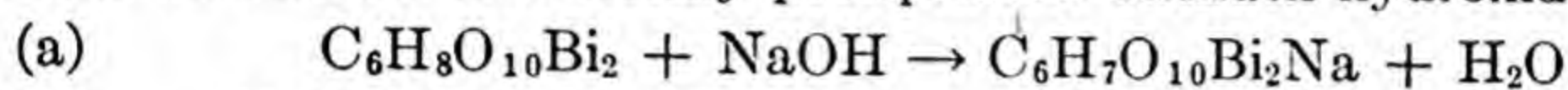
21

Bi₂C₆H₈O₁₀

NaOH

I-2697

Di-bismuthyl saccharic acid dissolved in 10% sodium hydroxide yielded, upon precipitation by alcohol, the acid, or monosodium salt. The sodium potassium bismuthyl salt (b) was obtained from sodium potassium saccharate and freshly precipitated bismuth hydroxide.



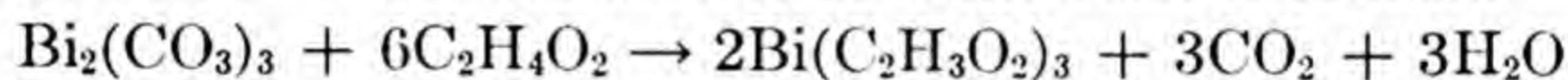
G. O. Doak, *J. Am. Pharm. A.*, **29**, 108 (1940)

112

Bi₂(CO₃)₃C₂H₄O₂

I-2698

2 gram-moles of bismuth carbonate to which 4 gram-moles mannite are added are boiled with 300 g. of glacial acetic acid for 2 hours using a reflux condenser. Bismuth acetate of white color is formed.



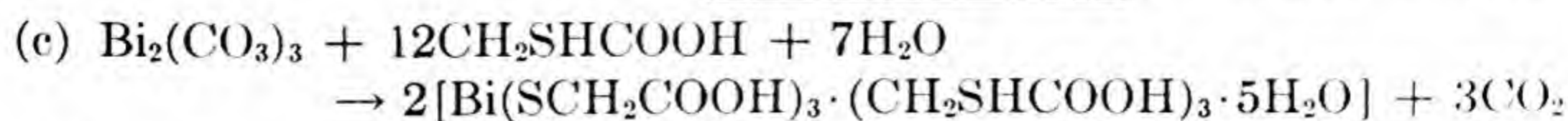
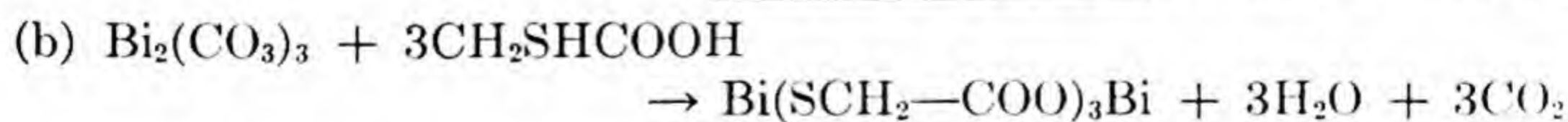
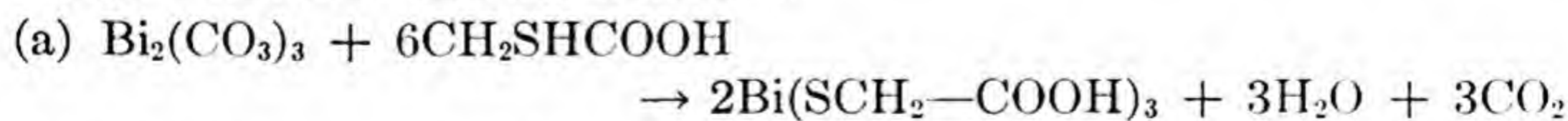
A. Rosenheim and W. Vogelsang, *Z. anorg. Chem.*, **48**, 205 (1906)

28

Bi₂(CO₃)₃CH₂SHCOOH

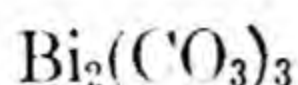
I-2699

Bismuth carbonate is dissolved in thioglycolic acid under gentle heating. After cooling and adding alcohol a crystalline precipitate of deep yellow color, bismuth thioglycolate, is formed. If a boiling solution of thioglycolic acid is used, bismuth thioglycolic acid bismuth is obtained. Finally at medium temperatures yellow colored crystal needles of a complex bismuth salt are obtained.

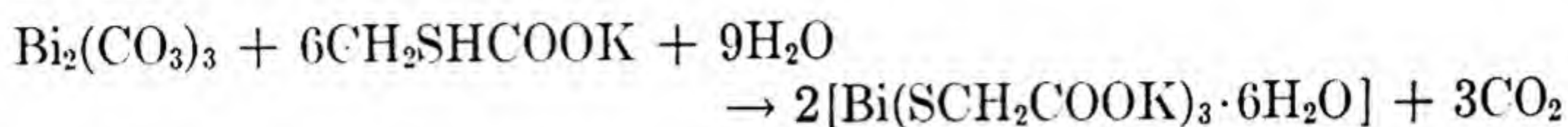


A. Rosenheim and I. Davidsohn, *Z. anorg. Chem.*, **41**, 231 (1904)

28

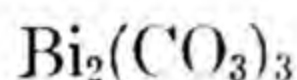
**CH₂SHCOOK****I-2700**

A solution of potassium thioglycolate is saturated with bismuth carbonate. Deep yellow colored crystals of a complex bismuth compound are formed.

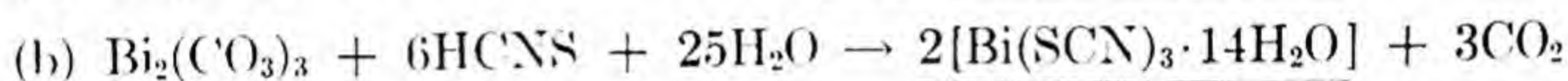
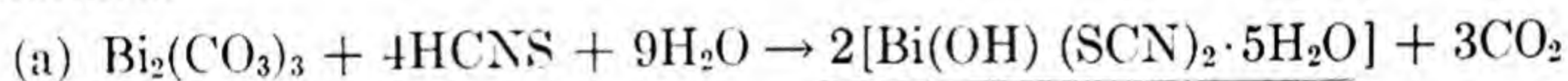


A. Rosenheim and I. Davidsohn, *Z. anorg. Chem.*, **41**, 231 (1904)

28

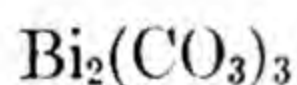
**HCNS****I-2701**

Bismuth carbonate is added to a 10% solution of hydrogen thiocyanate. Crystals of yellow color are formed. When the solution of hydrogen thiocyanate is saturated with bismuth carbonate, and afterwards concentrated in vacuo over sulfuric acid, needles of bismuth thiocyanate are formed.

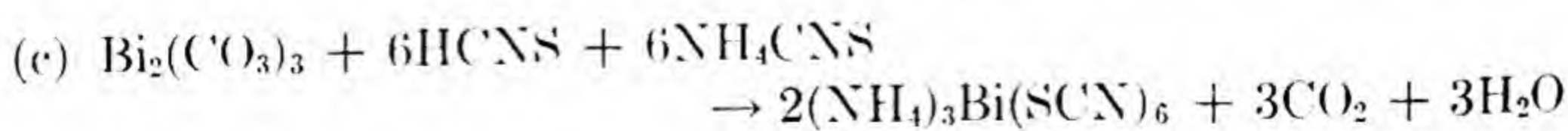
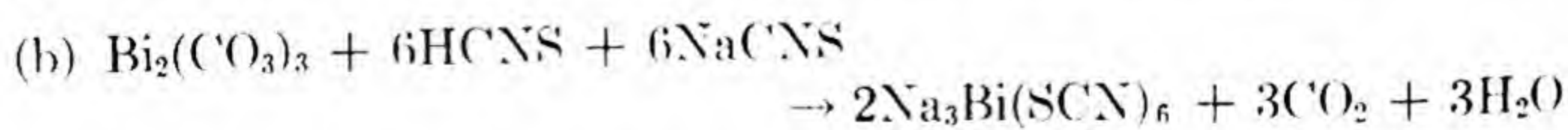
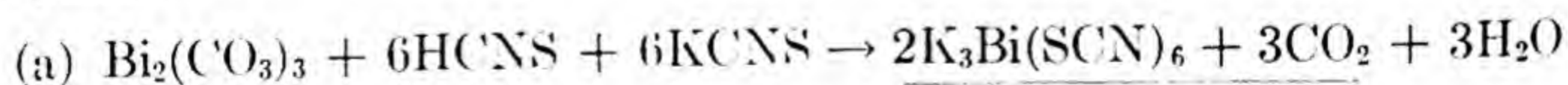


A. Rosenheim and W. Vogelsang, *Z. anorg. Chem.*, **48**, 205 (1906)

28

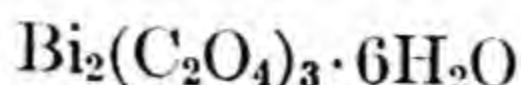
**HCNS, KCNS,****I-2702****NaCNS, NH₄CNS**

To a solution of bismuth carbonate in hydrogen thiocyanate potassium thiocyanate is added. By concentrating over sulfuric acid prismatic crystals of potassium bismuth hexathiocyanate are formed. The same type reaction occurs with sodium thiocyanate and ammonium thiocyanate.



A. Rosenheim and W. Vogelsang, *Z. anorg. Chem.*, **48**, 205 (1906)

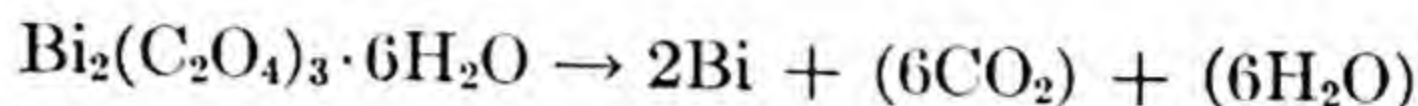
28



Δ

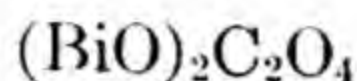
I-2703

Hydrated bismuth oxalate is decomposed by heating in a closed crucible over a low Bunsen flame.



Pattison Muir, J. Chem. Soc., **33**, 195 (1878)

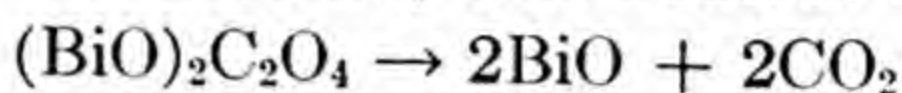
91



Δ

I-2704

Bismuthyl oxalate, when heated, yields bismuth monoxide.



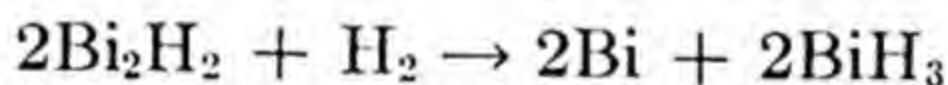
Tanatar, Z. Anorg. Chem., **27**, 437 (1901)

25

H₂

I-2705

Bismuth dihydride when heated in hydrogen yields bismuthine and metallic bismuth.



Vournasos, Compt. rend., **152**, 714 (1911)

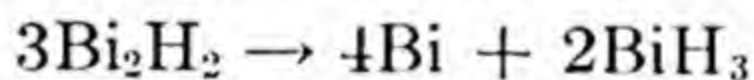
25



Δ

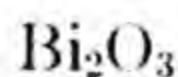
I-2706

Bismuth dihydride is heated in a vacuum.



Vournasos, Compt. rend., **152**, 714 (1911)

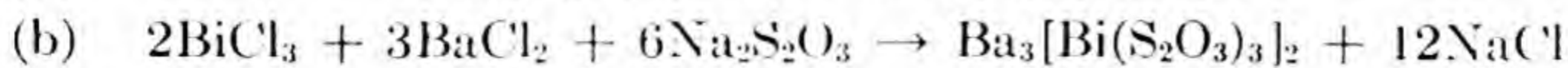
25

BaCl₂

I-2707

Na₂S₂O₃

Dissolve 10 grams of bismuth trioxide in 30 ml. of hydrochloric acid (d = 1.17). By adding a solution of 14 grams of barium chloride in 200 ml. of water and a solution of 30 grams of sodium thiosulfate in 150 ml. of water barium bismuth thiosulfate is formed. Alcohol will give a yellow colored precipitate.



O. Hauser, Z. anorg. Chem., **35**, 1 (1903)

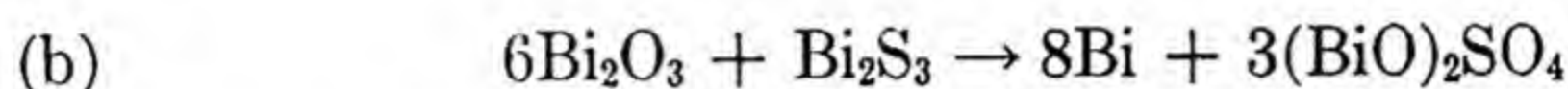
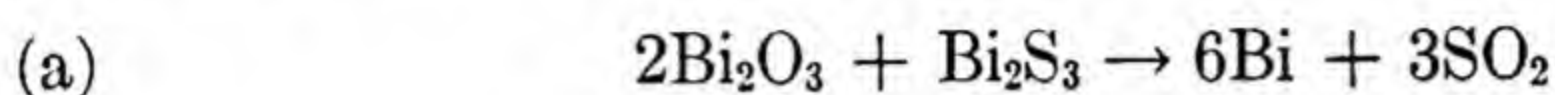
28



I-2708

Bismuth trioxide is reduced by bismuth trisulfide to metallic bismuth and sulfur dioxide when a mixture of the two is heated in a current of CO_2 , (a). A yield of 90% Bi was obtained.

A certain amount of basic bismuth sulfate was also recognized (b).



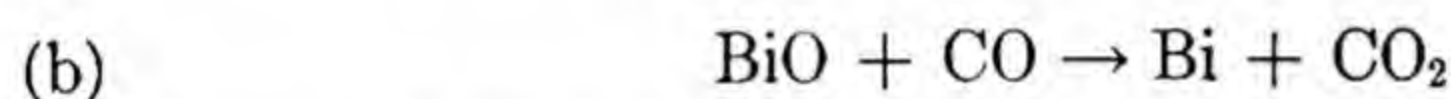
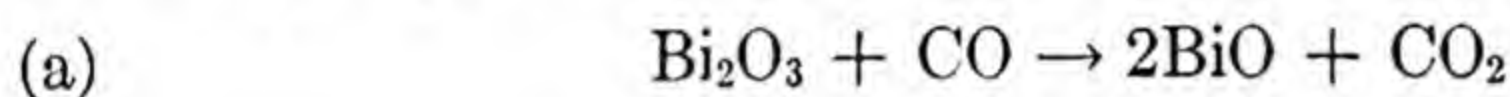
W. R. Schoeller, *J. Soc. Chem. Ind.*, **34**, 6 (1915)

25



I-2709

When bismuth oxide is heated in an atmosphere of carbon monoxide it is reduced partly to BiO and partly to Bi.



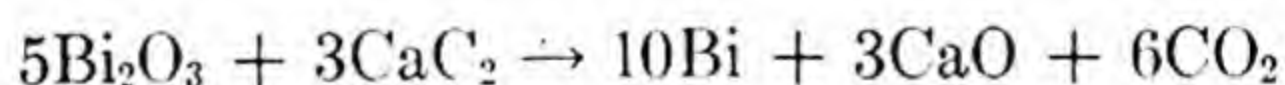
F. J. Brisbee, *J. Chem. Soc.*, (London), **93**, 164 (1908)

57



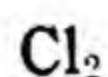
I-2710

Bismuth oxide is reduced to bismuth if it is heated with calcium carbide.



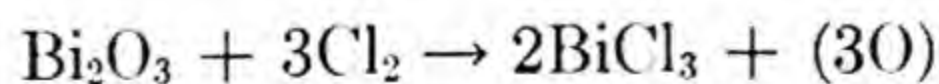
F. v. Kugelgen, *Z. Elektrochem.*, **7**, 573 (1901)

86



I-2711

Bismuth trichloride is formed when bismuth oxide is treated with chlorine.



Muir, *J. Chem. Soc.*, **39**, 22 (1881)

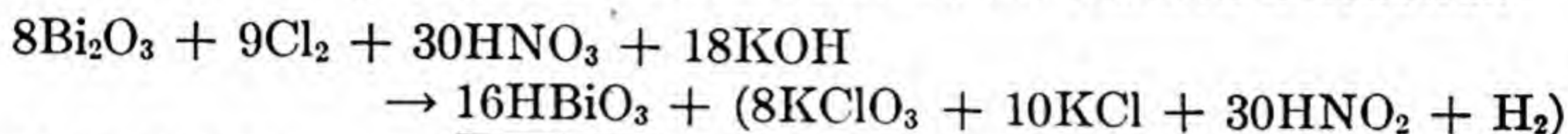
Ref., Hutchins and Lenher, *J. Am. Chem. Soc.*, **29**, 32 (1907)

1



I-2712

Dibismuth trioxide was suspended in exceedingly strong solution of caustic potash and while this was kept at the boiling point chlorine was passed into it. After some hours, the color of the suspended solid had changed to reddish-chocolate. When heated with nitric acid, metabismuthic acid precipitated out. However the reaction is doubtful.



M. M. P. Muir,

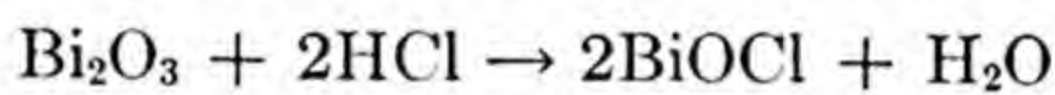
Ref., R. Gerstl., Ber., 9, 76 (1876)

26



I-2713

Bismuth trioxide reacts with dilute hydrochloric acid.

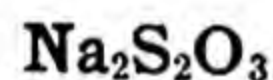


Muir, J. Chem. Soc., (London), 39, 36 (1881)

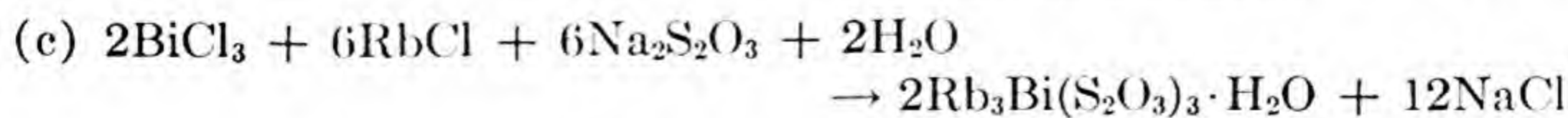
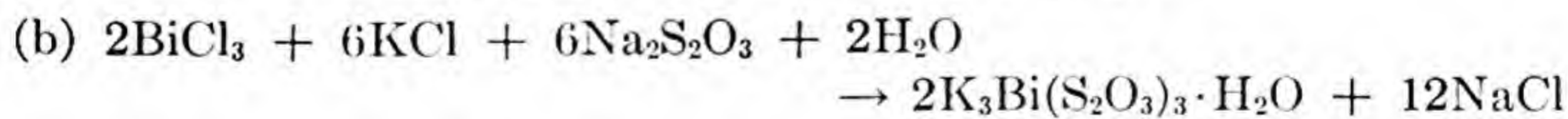
25



I-2714



Dissolve 10 grams of bismuth trioxide in 30 ml. of hydrochloric acid, add a solution of 9 grams of potassium chloride in 20 ml. of water and a solution of 30 grams of sodium thiosulfate in 50 ml. of water. At a temperature of 8° crystals of monohydrated potassium bismuth thiosulfate are obtained. The same type reaction occurs with rubidium chloride.



O. Hauser, Z. anorg. Chem., 35, 1 (1903)

28

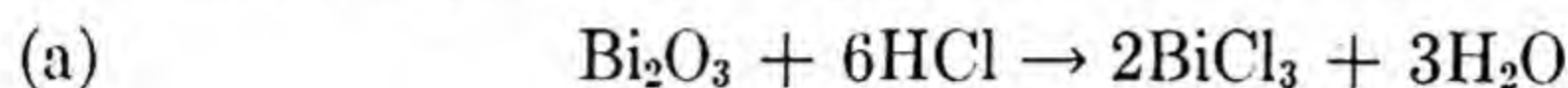


HCl

I-2715

KCl

Dipotassium chloro-bismuthite is produced when three molecular weights of bismuth oxide are dissolved in hydrochloric acid and two molecular weights of potassium chloride added.



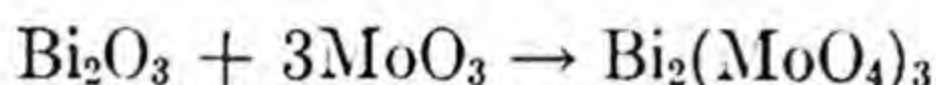
C. P. Brigham, *Am. Chem. J.*, **14**, 167 (1892)

1

MoO₃

I-2716

A mixture, containing the trioxides of bismuth and molybdenum, the latter being in slight excess, is fused.



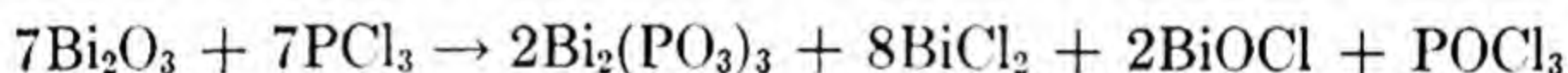
Bodman, *Z. Anorg. Chem.*, **27**, 254 (1901)

28

PCl₃

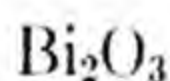
I-2717

Bismuth trioxide reacts with phosphorus trichloride when heated.



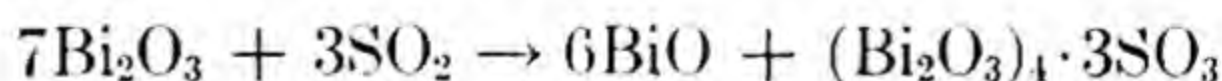
Michaelis, *J. prakt. Chem.* (2) **4**, 454 (1871)

25

SO₂

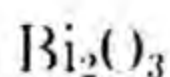
I-2718

Bismuth trioxide is reduced to the bismuthous form by means of SO₂, and also yielding a "basic sulfate."



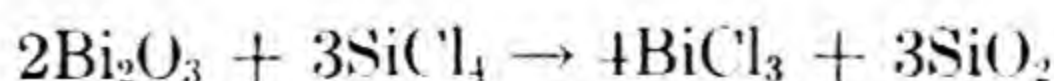
D. L. Hammrick, *J. Chem. Soc. (London)*, **3**, 387 (1917)

25

SiCl₄

I-2719

Bismuth trioxide reacts with silicon tetrachloride in a sealed tube heated to 370° to 380°.



Rauter, *Ann.*, **270**, 251 (1892)

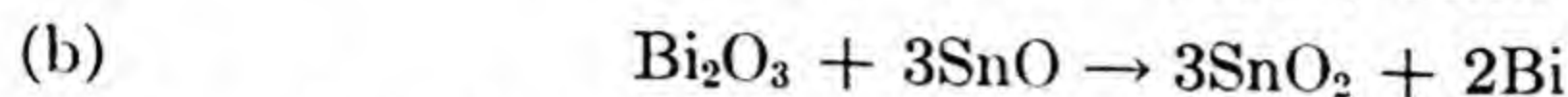
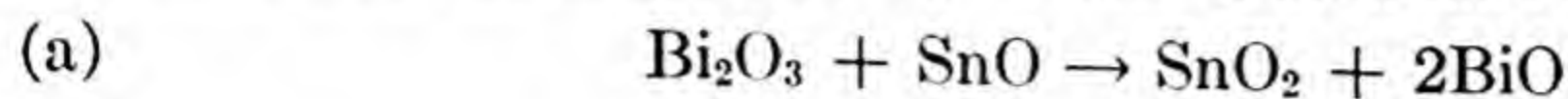
25

SnO

Bi₂O₃

I-2720

Bismuth trioxide is reduced by means of stannous oxide.



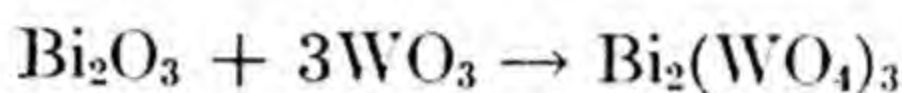
Vanino and Treubert, Ber., **31**, 1113 (1898)

25

WO₃Bi₂O₃

I-2721

An intimate mixture of the trioxides of bismuth and tungsten is fused.



Bodman, Z. anorg. Chem., **27**, 254 (1901)

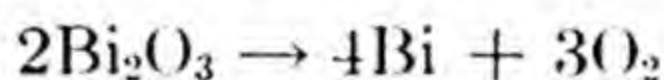
25

Δ

Bi₂O₃

I-2722

Bismuth oxide decomposes slowly when heated in a vacuum to 650°C.



F. Damm and F. Kraft Ber., **40**, 4775 (1907)

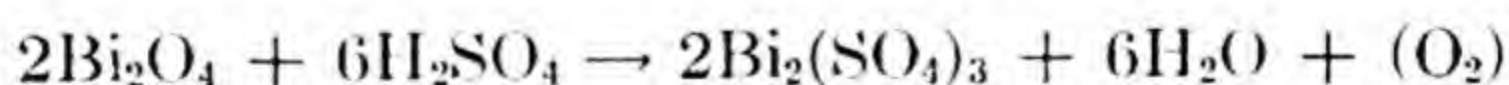
Ref., W. Robertson, J. Chem. Soc., (London), **94**, (2), 39 (1908)

57

H₂SO₄Bi₂O₄

I-2723

On heating bismuth tetroxide with sulfuric acid, bismuth sulfate is obtained.



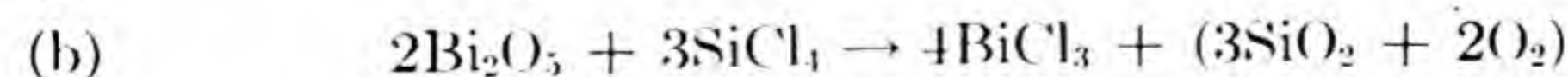
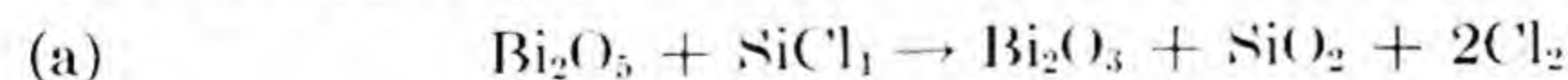
O. Hauser and L. Vanino, Z. anorg. Chem., **39**, 381 (1904)

28

SiCl₄Bi₂O₅

I-2724

Bismuth pentoxide reacts with silicon tetrachloride when heated to 370–380° in a sealed tube.

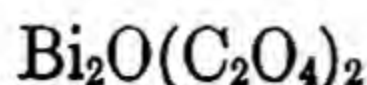


Rauter, Ann., **270**, 251 (1892)

Hutchins and Lenher, J. Am. Chem. Soc., **29**, 32 (1907)

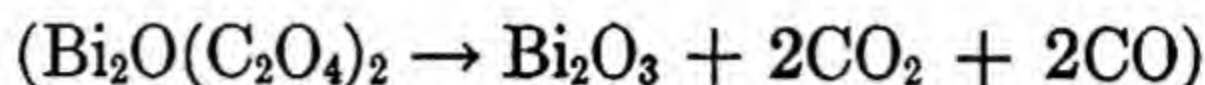
25

1

 Δ

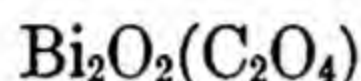
I-2725

Basic bismuth oxalate is decomposed by heat. The reaction begins at 150°.



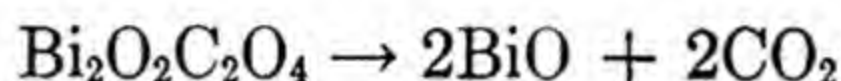
Pattison Muir, J. Chem. Soc., **33**, 196 (1878)

91

 Δ

I-2726

By heating basic bismuth oxalate, bismuth suboxide, a black powder, is obtained.

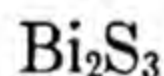


S. Tanatar, Z. anorg. Chem., **27**, 437 (1901)

28

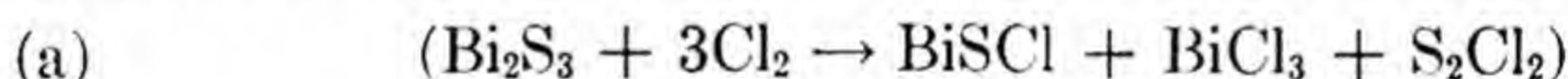
Ref., F. J. Brisbee, J. Chem. Soc., (London), **93**, 163 (1908)

57

 Cl_2

I-2727

Bismuth trisulfide reacts with chlorine at a low red heat yielding monothiochloride besides bismuth trichloride and sulfur monochloride.



M. M. P. Muir and E. M. Eagles, J. Chem. Soc. (London), **67**, 90 (1895)

25

 FeCl_3

I-2728

Bismuth trisulfide is decomposed by a solution of ferric chloride.



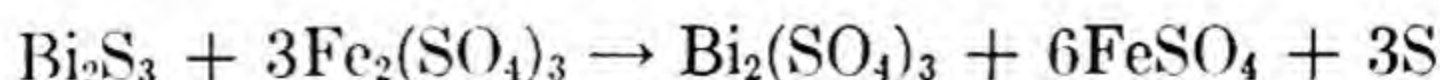
Cammerer, Berg u. Hütten Ztg., **50**, 295 (1891)

25

 $\text{Fe}_2(\text{SO}_4)_3$

I-2729

Bismuth trisulfide is oxidized by ferric sulfate.



Hanus, Z. Anorg. Chem., **17**, 111 (1898)

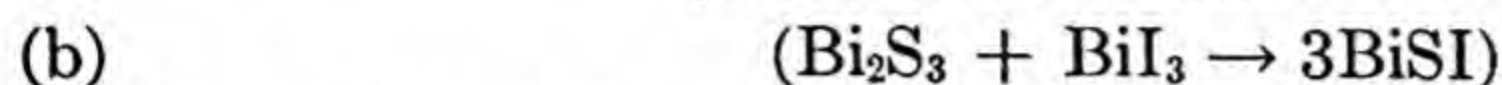
28


 I_2

I-2730

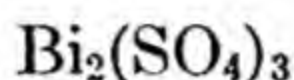
 BiI_3

The compound bismuth thioiodide may be formed by heating a mixture of bismuth sulfide and iodine. The same bismuth compound may be formed by adding bismuth trisulfide to hot bismuth iodide.



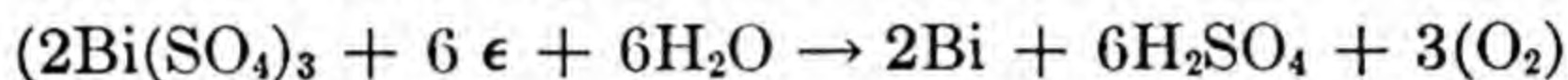
Muir and Eagles, J. Chem. Soc. (London), **67**, 90 (1895)

108


 ϵ

I-2731

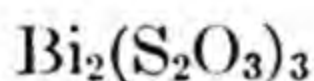
Bismuth, in solution as sulfate or citrate, was deposited in compact form by three bichromate cells in series. The reduction goes on equally well in a solution containing an excess of citric acid.



N. W. Thomas and E. F. Smith, Am. Chem. J., **5**, 114 (1883)

Ref., C. F. M., Science, **2**, 141 (1883)

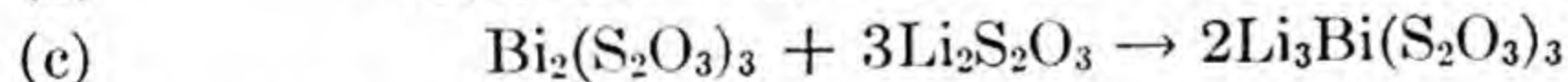
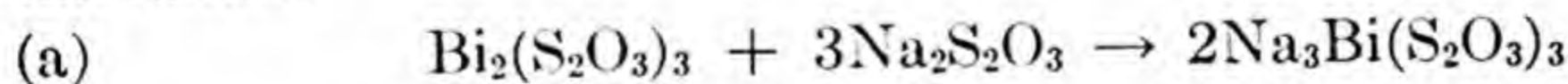
73


 $\text{Na}_2\text{S}_2\text{O}_3$

I-2732

 $(\text{NH}_4)_2\text{S}_2\text{O}_3$
 $\text{Li}_2\text{S}_2\text{O}_3$

A solution of bismuth thiosulfate will react with a solution of sodium thiosulfate yielding sodium bismuth thiosulfate, a liquid of yellow color. The same type reaction occurs with ammonium thiosulfate and lithium thiosulfate.



O. Hauser, Z. anorg. Chem., **35**, 1 (1903)

28

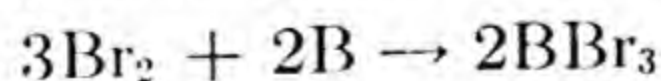
BORON

B

 Br_2

I-2733

Bromine reacts with boron to form the tribromide.



H. E. Cocksedge, J. Chem. Soc., (London), **93**, 2177 (1908)

57

Ref., Meyer and Zappner, Ber., **54B**, 550 (1921)

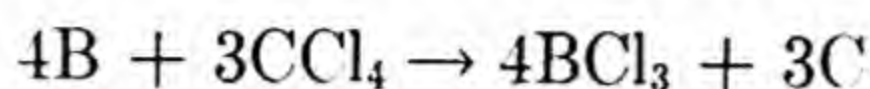
25

B

CCl₄

I-2734

Boron reacts with carbon tetrachloride at 200° to 250°.



P. C. Chabrie, *Bull. Soc. Chim.* [3] 7, 18 (1892)

31

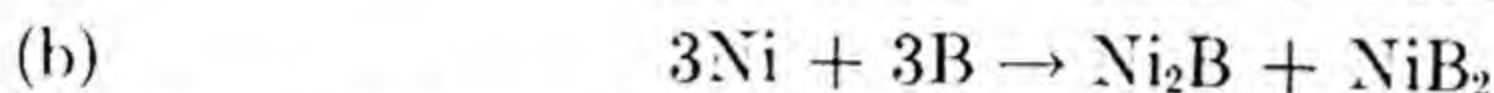
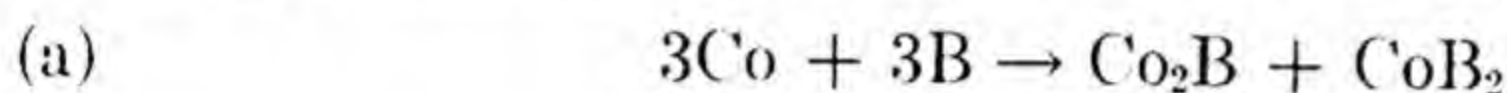
B

Co

I-2735

Ni

Two borides of cobalt and nickel are obtained when a mixture of the elements is heated at 1100–1200° in a current of hydrogen.



Du Jassonneix, *Compt. rend.*, **143**, 897, 1149; **145**, 121, 240

Ref., J. L. Howe, *J. Am. Chem. Soc.*, **30**, 627 (1908)

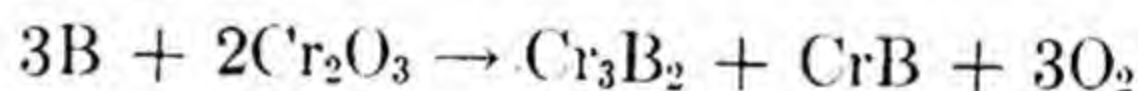
1

B

Cr₂O₃

I-2736

Two borides of chromium are formed when boron reduces chromium oxide in the electric furnace.



Du Jassonneix, *Compt. rend.*, **143**, 897, 1149 (1906); **145**, 121, 240 (1907)

Ref., J. L. Howe, *J. Am. Chem. Soc.*, **30**, 627 (1908)

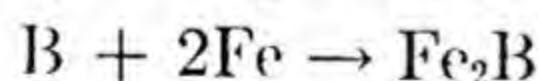
1

B

Fe

I-2737

A boride of iron is prepared by heating a mixture of reduced iron with boron either in an electric or gas furnace.



Du Jassonneix, *Compt. rend.*, **143**, 897, 1149 (1906); **145**, 121, 240 (1907)

Ref., J. L. Howe, *J. Am. Chem. Soc.*, **30**, 627 (1908)

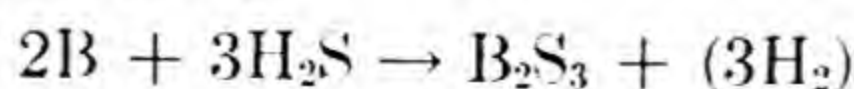
1

B

H₂S

I-2738

Hydrogen sulfide, mixed with an equal volume of hydrogen reacts with boron when heated to 1500°.



D. Costeum, *Compt. rend.*, **157**, 934 (1913)

38

B

MnO₂**I-2739**

Two borides of manganese are formed when boron reduces manganese dioxide in an electric furnace.



Du Jassonneix, *Compt. rend.*, **143**, 897, 1149 (1906); **145**, 121, 240 (1907)

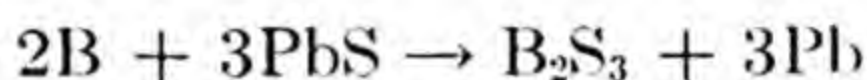
Ref., J. L. Howe, *J. Am. Chem. Soc.*, **30**, 627 (1908)

1

B

PbS**I-2740**

Boron is melted with lead sulfide.



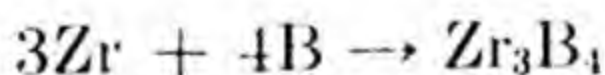
Wöhler and Deville, *Ann. Chim. Phys.* (3) **52**, 90 (1858)

76

B

Zr**I-2741**

Zirconium boride can be made by heating a mixture of zirconium and boron with the aid of an electric current of 200 amperes and 65 volts. Other borides such as chromium, tungsten, and molybdenum—CrB, WB₂, and Mo₃B₄—can be formed by a similar method.

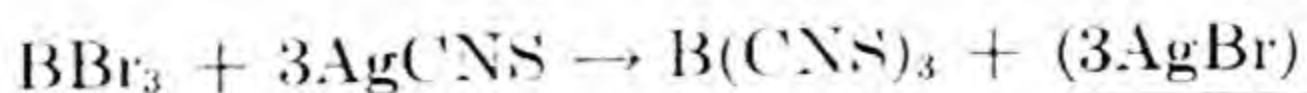


S. A. Tucker and H. R. Moody, *J. Chem. Soc. (London)*, **81**, 15 (1902)

102

BBr₃**AgCNS****I-2742**

A small bulb of BBr₃ and dried AgCNS were placed in a bottle with pure benzene. The bulb was broken by shaking and the shaking was continued for a few minutes. The solution was filtered, and the benzene removed by evaporation.



H. E. Cocksedge, *J. Chem. Soc. (London)*, **93**, 2178 (1908)

57

**CH₃CN****I-2743**

Boron bromide dissolved in carbon tetrachloride forms insoluble 1:1 addition products with organic nitriles. Methyl, ethyl, phenyl and benzyl cyanides all enter into the same reaction. It may be noted further that these addition compounds, like amine-boron bromide addition complexes, react more or less violently with solvents containing oxygen.

- (a) $\text{CH}_3\text{CN} + \text{BBr}_3 \rightarrow \text{CH}_3\text{CN} \cdot \text{BBr}_3$
 (b) $\text{C}_2\text{H}_5\text{CN} + \text{BBr}_3 \rightarrow \text{C}_2\text{H}_5\text{CN} \cdot \text{BBr}_3$
 (c) $\text{C}_6\text{H}_5\text{CN} + \text{BBr}_3 \rightarrow \text{C}_6\text{H}_5\text{CN} \cdot \text{BBr}_3$
 (d) $\text{C}_6\text{H}_5\text{CH}_2\text{CN} + \text{BBr}_3 \rightarrow \text{C}_6\text{H}_5\text{CH}_2\text{CN} \cdot \text{BBr}_3$

A. R. Johnson, *J. Phys. Chem.*, **16**, 1 (1912)

7

**CH₃NH₂****I-2744**

Several reaction products of boron tribromide with aliphatic amines can be prepared by passing the amine into a solution of BBr₃ in carbon tetrachloride. Methyl amine forms a white precipitate; ethyl amine yields an amorphous product; iso-amyl amine reacts to give an insoluble precipitate and aniline forms an insoluble 1:1 addition compound.

- (a) $2\text{CH}_3\text{NH}_2 + \text{BBr}_3 \rightarrow \underline{(\text{CH}_3\text{NH})_2\text{BBr}} + 2\text{HBr}$
 (b) $\text{C}_2\text{H}_5\text{NH}_2 + \text{BBr}_3 \rightarrow \text{C}_2\text{H}_5\text{NH} \cdot \text{BBr}_2 + \text{HBr}$
 (c) $\text{C}_5\text{H}_{11}\text{NH}_2 + \text{BBr}_3 \rightarrow \underline{\text{C}_5\text{H}_{11}\text{NH}_2 \cdot \text{BBr}_3}$
 (d) $\text{C}_6\text{H}_5\text{NH}_2 + \text{BBr}_3 \rightarrow \underline{\text{C}_6\text{H}_5\text{NH}_2 \cdot \text{BBr}_3}$

A. R. Johnson, *J. Phys. Chem.*, **16**, 1 (1912)

7

**C₅H₅N****I-2745**

The cyclic amines, pyridine and quinoline, react also with boron tribromide in carbon tetrachloride solution. The first gives a 1:1 addition product which slowly loses hydrobromic acid. Quinoline adds in the ratio 1 to 1 giving a stable product.

- (a) $\text{C}_5\text{H}_5\text{N} + \text{BBr}_3 \rightarrow \text{C}_5\text{H}_5\text{N} \cdot \text{BBr}_3$
 (b) $\text{C}_5\text{H}_5\text{N} \cdot \text{BBr}_3 \rightarrow \text{C}_5\text{H}_4\text{N} \cdot \text{BBr}_2 + \text{HBr}$
 (c) $\text{C}_9\text{H}_7\text{N} + \text{BBr}_3 \rightarrow \text{C}_9\text{H}_7\text{N} \cdot \text{BBr}_3$

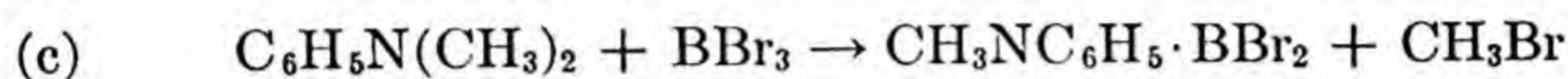
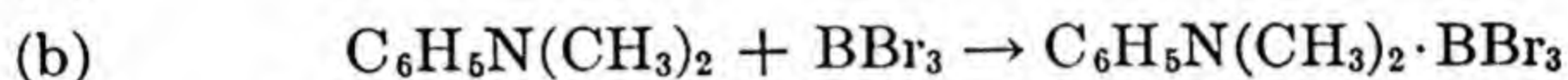
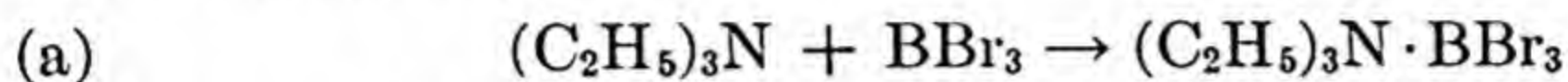
A. R. Johnson, *J. Phys. Chem.*, **16**, 1 (1912)

7



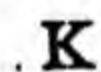
I-2746

Tertiary amines react with boron bromides in carbon tetrachloride. Triethyl amine produces a 1:1 addition product, (a). Dimethyl aniline gives also 1:1 addition, but the product decomposes on slight warming in a desiccator (with sodium hydroxide and calcium chloride) to give a new substance, (b). This last compound in hot alkali gives rise to a white insoluble powder.



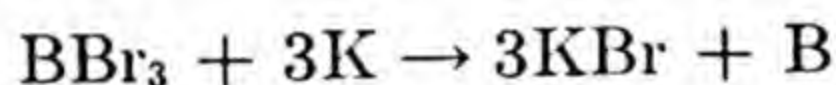
A. R. Johnson, *J. Phys. Chem.*, **16**, 1 (1912)

7



I-2747

Boron tribromide is reduced by metallic potassium.



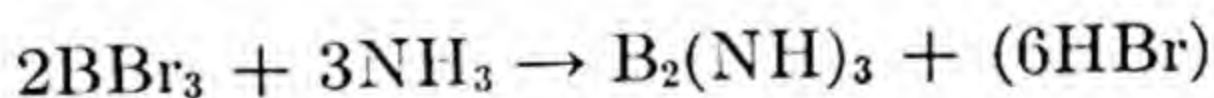
A. C. Vournasos, *Z. anorg. Chem.*, **81**, 364 (1913)

28



I-2748

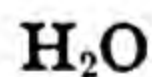
A boron imide is formed by the action of ammonia upon boron bromide at a low temperature.



Joannis, *Compt. rend.*, **139**, 364

Ref., *J. Am. Chem. Soc.*, **27**, 71 (1905)

1



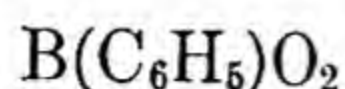
I-2749

When exposed to moisture, boron thiocyanate is hydrolyzed at once.



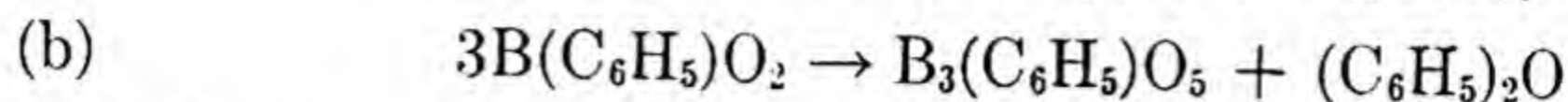
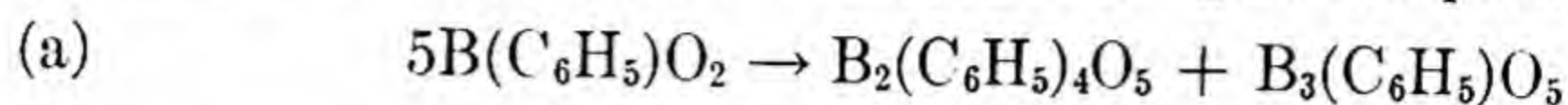
H. E. Cocksedge, *J. Chem. Soc. (London)*, **93**, 2178 (1908)

57

 Δ

I-2750

When heated to around 300°, phenyl borate decomposes into phenyl triborate and tetraphenyl diborate, a dense golden liquid.



H. Schiff and E. Bechi, *Compt. Rend.*, **62**, 398 (1866)

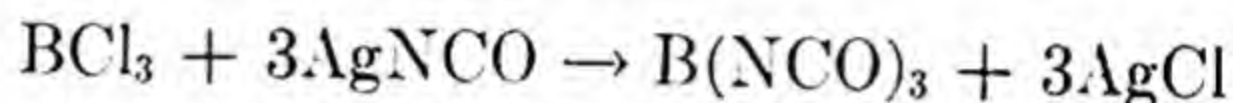
29



AgNCO

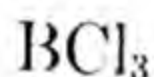
I-2751

Silver isocyanate, boron chloride and warm benzene are shaken in a flask. The normal cyanate is formed.



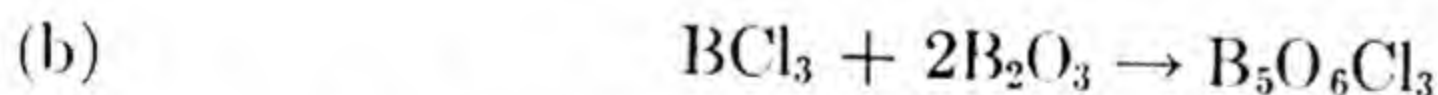
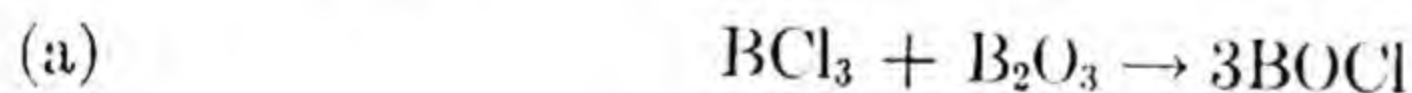
G. S. Forbes and H. H. Anderson, *J. Am. Chem. Soc.*, **62**, 761 (1940)

3

 B_2O_3

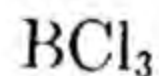
I-2752

It was formerly believed that the oxychloride obtained by passing boron trichloride over heated boron trioxide was that shown in (a), but later work indicates that the product formed is that shown in equation (b).



R. Lorenz, *Ann.*, **247**, 241 (1888)

25

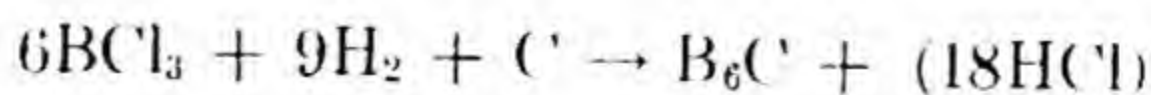


C

I-2753

 H_2

Boron trichloride vapor mixed with hydrogen and passed over a carbon rod at 1800° produces boron carbide. Silicon tetrachloride and tungsten hexachloride react in a similar manner.

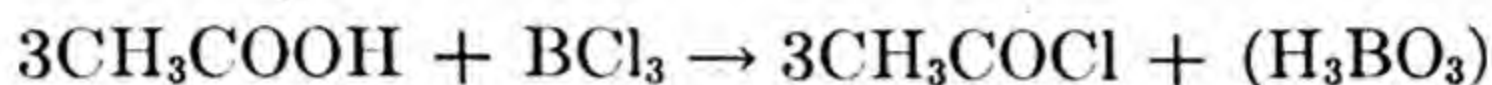


J. N. Pring and W. Fielding, *J. Chem. Soc.*, (London), **95**, 1500 (1909)

57

CH₃COOHBCl₃**I-2754**

Acetyl chloride is formed when boron trichloride acts on acetic acid.



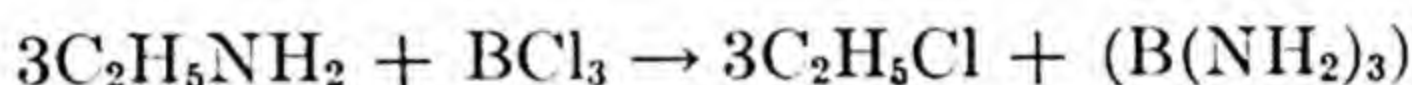
Gustavson,

Ref., V. von Richter, Ber., **3**, 427 (1870)

11

BCl₃**C₂H₅NH₂****I-2755**

Ethyl chloride is formed when boron trichloride reacts with ethyl amine.



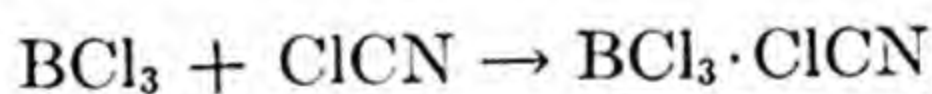
Gustavson,

Ref., V. von Richter, Ber., **3**, 427 (1870)

11

BCl₃**ClCN****I-2756**

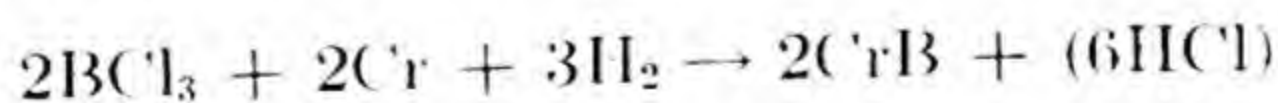
Boron trichloride absorbs chlorocyanogen gas forming a white crystalline precipitate whose analysis corresponds to the formula given below. Martius reported this compound, but apparently made no analysis of it.

A. R. Johnson, J. Phys. Chem., **16**, 1 (1912)Ref., Martius, Ann., **109**, 80 (1859)

7

BCl₃**Cr****I-2757****H₂**

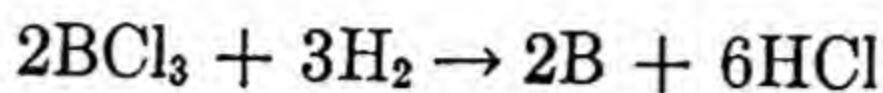
When boron trichloride is carried in a current of hydrogen over finely divided chromium at 1100°, chromium boride is formed.

Du Jassonneix, Ann. Chim. Phys., [8], **17**, 145 (1909)Ref., J. L. Howe, J. Am. Chem. Soc., **31**, 1284 (1909)

1

**H₂****I-2758**

Boron trichloride is reduced by hydrogen under the influence of an electric discharge.



Besson and Fournier, *Compt. rend.*, **150**, 872 (1910)

Ref., Weintraub, *J. Ind. & Eng. Chem.*, **3**, 299 (1911)

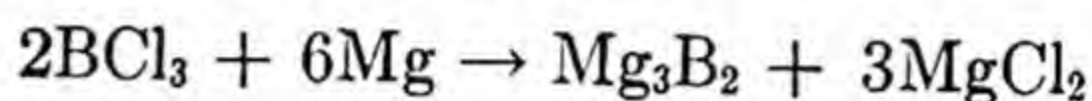
Ref., J. L. Howe, *J. Am. Chem. Soc.*, **34**, 148 (1912)

38

1

**Mg****I-2759**

Boron trichloride is reduced by magnesium.

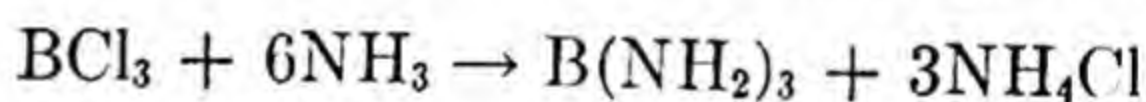


Jones and Taylor, *J. Chem. Soc.*, (London), **39**, 213 (1881)

48

**NH₃****I-2760**

Boron trichloride reacts with liquid ammonia to produce boron amide.



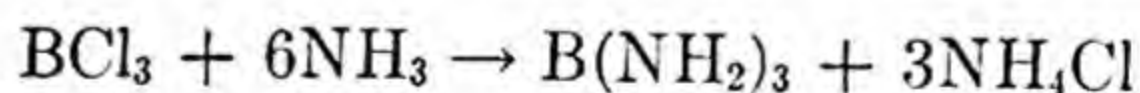
Joannis, *Compt. rend.*, **135**, 1106 (1903)

Ref., E. C. Franklin, *J. Am. Chem. Soc.*, **27**, 826 (1905)

1

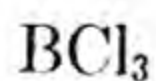
**NH₃****I-2761**

Boron trichloride reacts with ammonia at 0°.

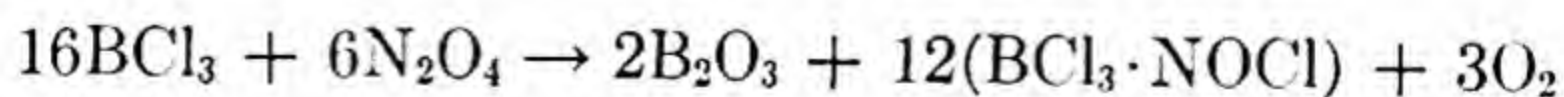


A. Joannis, *Compt. rend.*, **135**, 1106 (1902)

25

**N₂O₄****I-2762**

Boron trichloride is treated with nitrogen tetroxide.



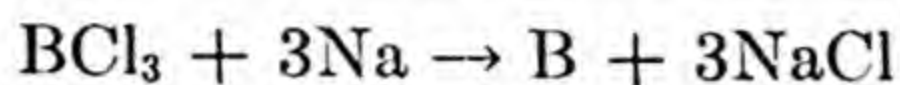
A. Geuther, *J. prakt. Chem.*, (2) **8**, 357 (1873)

25



Na **I-2763**

Metallic sodium reduces boron trichloride to boron at 150°C.



Gustavson,

Ref., V. von Richter, Ber., **3**, 427 (1870)

11



O₂ **I-2764**

Electric sparks are passed through a mixture of boron trichloride and oxygen.



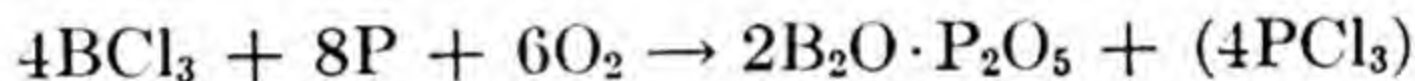
Becker and Michaelis, Ber., **13**, 58 (1880)

25



P + O₂ **I-2765**

Boron trichloride is passed over red phosphorus in the presence of a limited amount of oxygen.



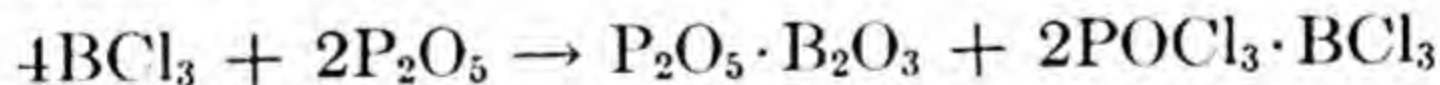
W. Kroll, J. Chem. Soc. (London), **114**, 109 (1918)

57



P₂O₅ **I-2766**

Boron trichloride when heated to 200°C for 2-3 days with phosphorus pentoxide forms two double compounds.



Gustavson,

Ref., Von Richter, Ber., **4**, 976 (1871)

11



P₂O₅ **I-2767**

Boron trichloride is heated with phosphorus pentoxide in a sealed tube.



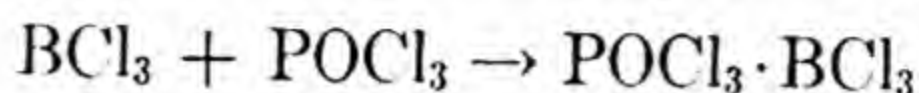
G. Gustavson, Ann. Chim. phys., (5) **2**, 200 (1874)

25



I-2768

When a stream of boron trichloride is passed into phosphorus oxychloride, crystals of a double compound separate out immediately.



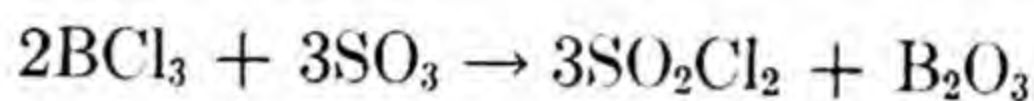
Gustavson,
Ref., Von Richter, Ber., **4**, 976 (1871)

11



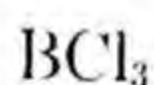
I-2769

A mixture of boron trichloride and sulfur trioxide is heated to 150° in a sealed tube.



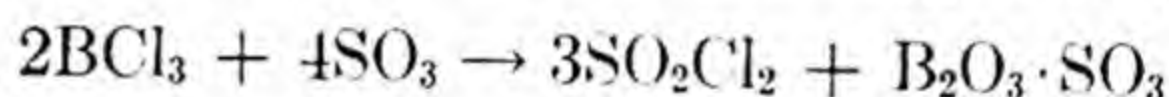
G. Gustavson, Ann. Chim. phys., (5) **2**, 200 (1874)

25



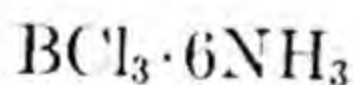
I-2770

Boron trichloride acts on sulfur trioxide to form SO_2Cl_2 and $\text{B}_2\text{O}_3 \cdot \text{SO}_3$.



Gustavson, Gazz. Chim. ital., **3**, 199 (1873)

21



I-2771

Boron trichloride hexammoniate is heated.



A. Joannis, Compt. rend., **135**, 1106 (1902)

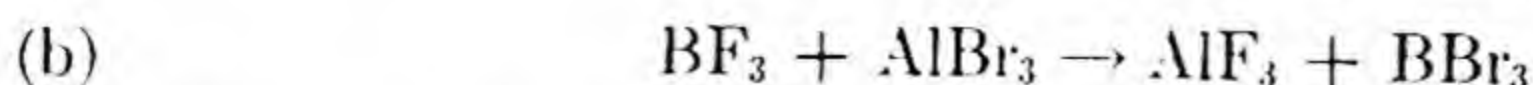
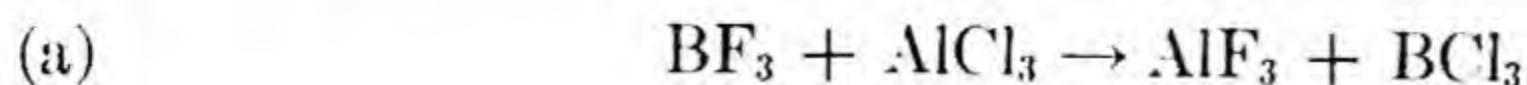
25



I-2772



Boron fluoride reacts with aluminum chloride to produce good yields of boron trichloride. Aluminum bromide reacts similarly.



E. L. Gamble, O. Gilmont and J. I. Stiff, J. Am. Chem. Soc., **62**, 1257 (1940)

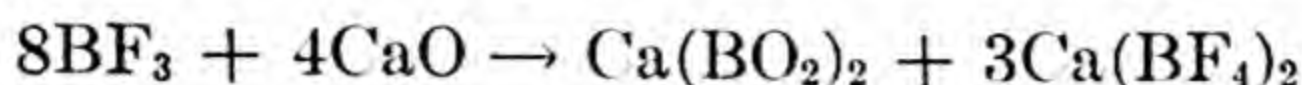
3



CaO

I-2773

Boron trifluoride is absorbed by calcium oxide when warmed.



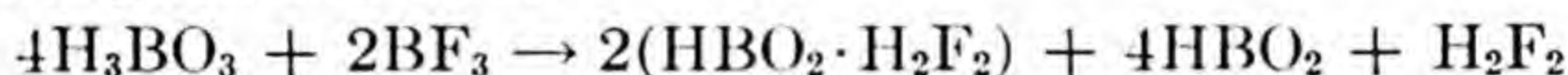
J. Davy, New Edin. Phil. J., **17**, 246 (1812)

25

H₃BO₃

I-2774

An excess of boron fluoride is passed into solid orthoboric acid contained in a "Pyrex" flask. The contents of the flask soon becomes warm and the contents liquefies. The liquid distills and gives a quantitative yield of dihydroxyfluoboric acid.



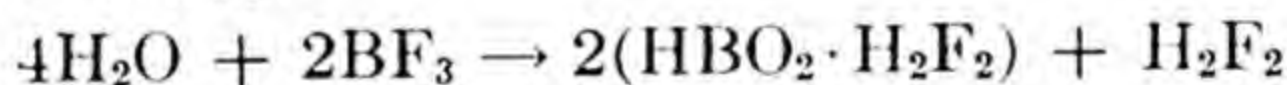
F. J. Sowa, J. W. Kroeger and J. A. Nieuwland, J. Am. Chem. Soc., **57**, 454 (1935)

3

H₂O

I-2775

Boron fluoride is passed into water until the increase in weight corresponds to the ratio of one boron fluoride to two waters, and the solution is distilled at atmospheric pressure. Hydrogen fluoride is given off and a small amount of dihydroxyfluoboric acid can be isolated. The yield is only 3 to 5%.



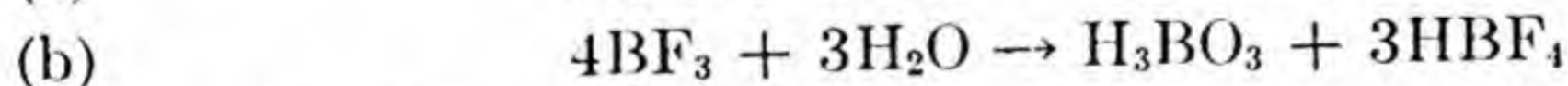
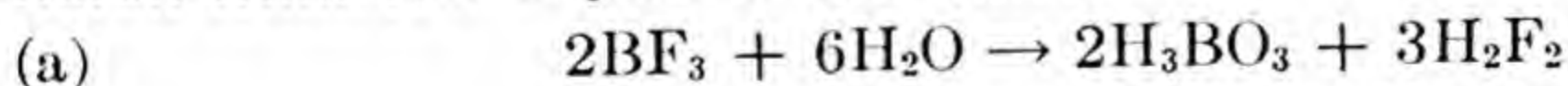
F. J. Sowa, J. W. Kroeger and J. A. Nieuwland, J. Am. Chem. Soc., **57**, 454 (1935)

3

H₂O

I-2776

Boron trifluoride is passed into water.



J. Davy, New Edin. Phil. J., **17**, 246 (1812)

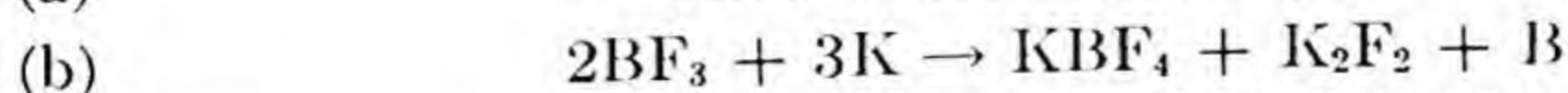
25



K

I-2777

Boron trifluoride is passed over heated potassium.



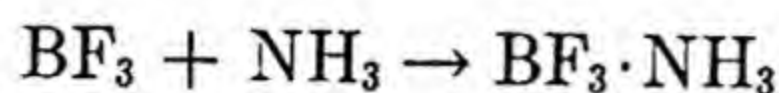
Gay Lussac and Thenar, Ann. Chim. phys. II, **69**, 204 (1908)

25



I-2778

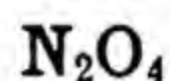
Borontrifluoride monammoniate is formed when boron trifluoride is passed into dry ammonia.



Mixer, Am. Chem. J., **2**, 153 (1881)

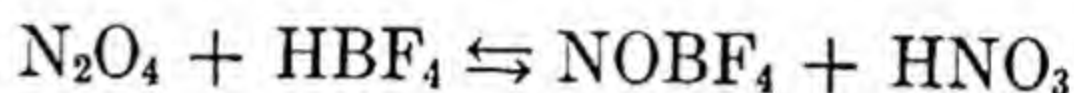
Ref., Kraus and Brown, J. Am. Chem. Soc., **51**, 2691 (1929)

1



I-2779

A strong solution of fluoboric acid is treated with nitrogen tetroxide, precipitating a gel-like nitrosyl-fluoborate.



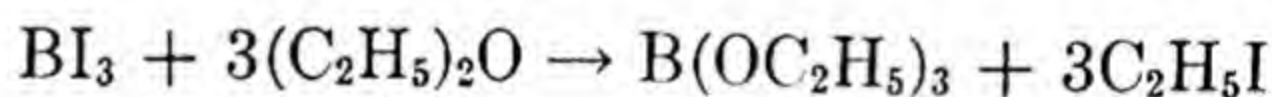
Voznesensky and Kursky, J. Gen. Chem. (USSR), **8**, 524-8 (1938)

60



I-2780

Boron triiodide reacts with ethyl ether.



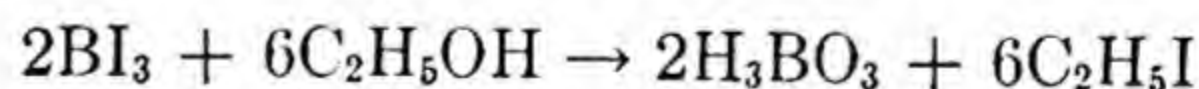
H. Moissan, Compt. rend., **112**, 717 (1891)

29



I-2781

Boron triiodide reacts with absolute alcohol.



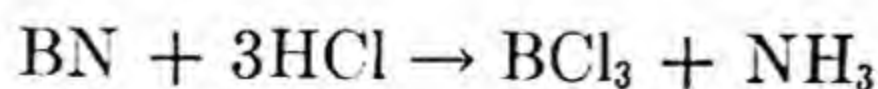
H. Moissan, Compt. rend., **112**, 717 (1891)

29



I-2782

Boron nitride reacts with gaseous HCl at 650-1050°.



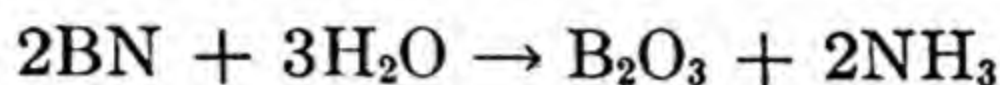
Montemartini and Losana, Giorn. Chim. ind. applicata, **6**, 323 (1924)

25

BN

H₂O**I-2783**

When steam is passed over boron nitride, hydrolysis is complete.

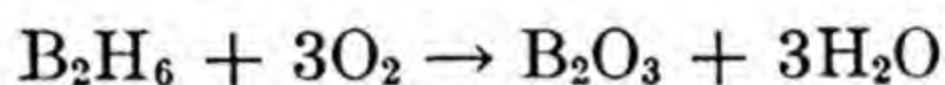


F. Weston and H. Russell, *Trans. Far. Soc.*, **3**, 174 (1907)

85

B₂H₆**O₂****I-2784**

Boron hydride is exploded with oxygen.



Stock and Friederici, *Ber.*, **46**, 1959 (1913)

25

BO·OC₂H₅**Δ****I-2785**

Upon heating to 250°–290°, monoethyl borate decomposes into triethoxyboron and monoethyl triborate.

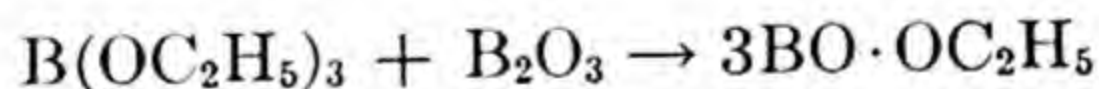


H. Schiff and E. Bechi, *Compt. Rend.*, **61**, 698 (1865)

29

B(OC₂H₅)₃**B₂O₃****I-2786**

Monoethyl borate is formed when triethoxyboron is heated with boron trioxide.

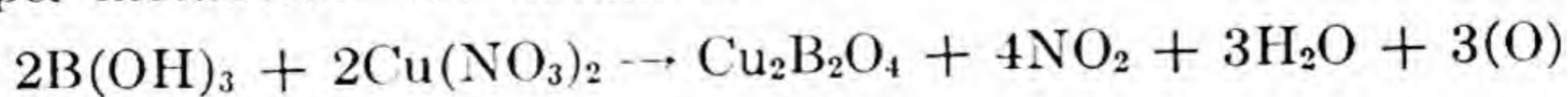


H. Schiff and E. Bechi, *Compt. Rend.*, **61**, 697 (1865)

29

B(OH)₃**Cu(NO₃)₂****I-2787**

By evaporating a solution containing 2 moles of boric acid and 1 mole of copper nitrate to dryness and thereafter heating in a platinum crucible to a temperature lower than 900°, blue colored crystals of copper metaborate are obtained.



W. Guertler, *Z. anorg. Chem.*, **38**, 456 (1904)

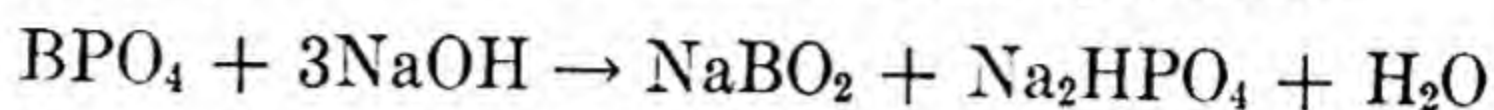
28

NaOH

BPO₄

I-2788

Boron orthophosphate is fused with sodium hydroxide.



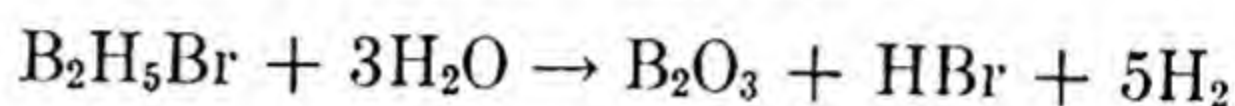
G. Prescher, Arch. Pharm., **242**, 194 (1904)

25

H₂OB₂H₅Br

I-2789

Boron monobromhydride reacts with water.



Stock, Kuss and Priess, Ber., **47**, 3121 (1914)

25

Na

B₂H₅I

I-2790

Iododiboron pentahydride and sodium react according to the Wurtz synthesis.



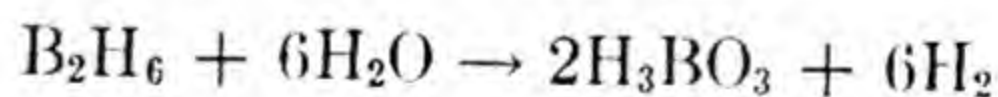
S. H. Bauer, J. Am. Chem. Soc., **60**, 805 (1938)

3

H₂OB₂H₆

I-2791

Boron hydride reacts vigorously with water.



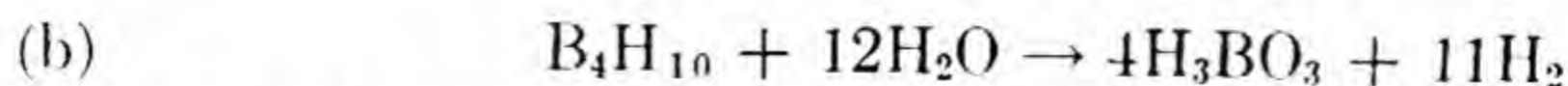
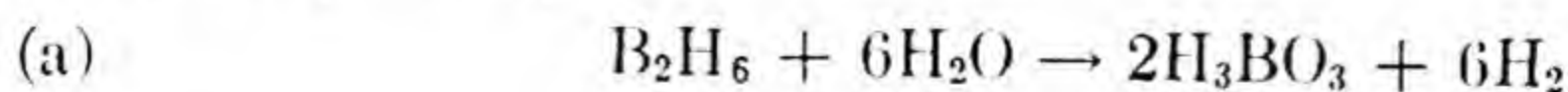
Stock and Friederici, Ber., **46**, 1959 (1913)

25

H₂OB₂H₆

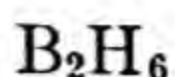
I-2792

Boron hydrides hydrolyze at different rates. Boron hexahydride hydrolyzes with traces of water in a few seconds, while the decahydride reacts very slowly.



A. Stock, Z. Elektrochem., **19**, 780 (1913)

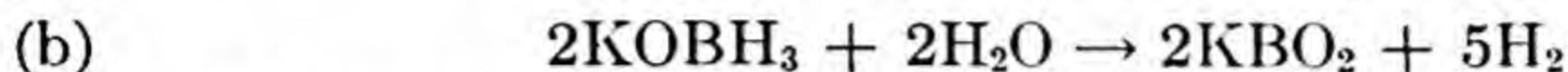
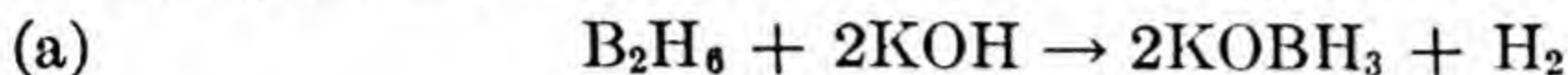
86



KOH

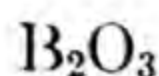
I-2793

Boron hydride reacts with potassium hydroxide at room temperature.



Stock and Kuss, *Ber.*, **47**, 816 (1914)

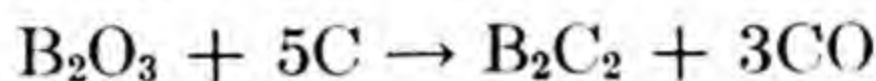
25



C

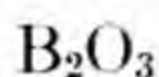
I-2794

Black boron carbide is obtained by heating boron oxide with carbon at a very high temperature, e.g. using an electric current of 350 amp. and 50 volts to generate the heat.



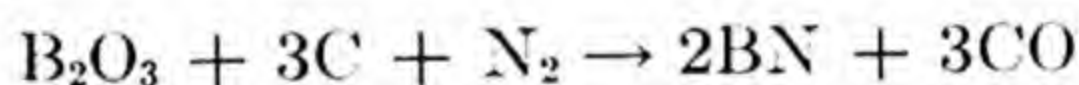
O. Mühlhauser, *Z. anorg. Chem.*, **5**, 92 (1894)

28

C + N₂

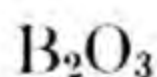
I-2795

A mixture of boron trioxide and carbon is heated to 1300° in an atmosphere of nitrogen.



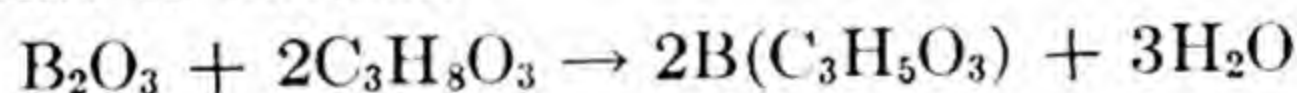
A. Stähler and J. J. Elbert, *Ber.*, **46**, 2060 (1913)

25

C₃H₈O₃

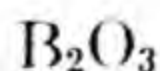
I-2796

When boron trioxide is heated with glycerine, water is eliminated and a boron glycerate is formed.



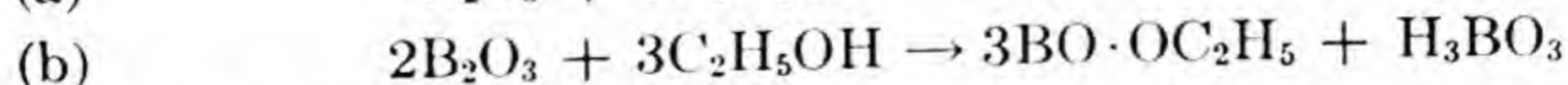
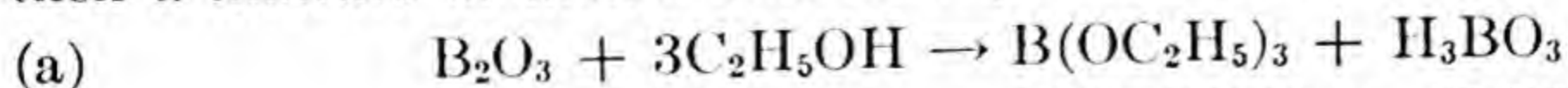
Schiff and Bechi, *Compt. Rend.*, **62**, 398 (1866)

29

C₂H₅OH

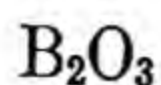
I-2797

By heating boron trioxide with an excess of alcohol at 120° in a sealed tube, triethyl borate and boric acid are formed. The triethyl borate can be separated from the excess alcohol by fractional distillation. If an excess of boron trioxide is used instead of an excess of alcohol, then a mixture of mono- and triethyl borate is formed.



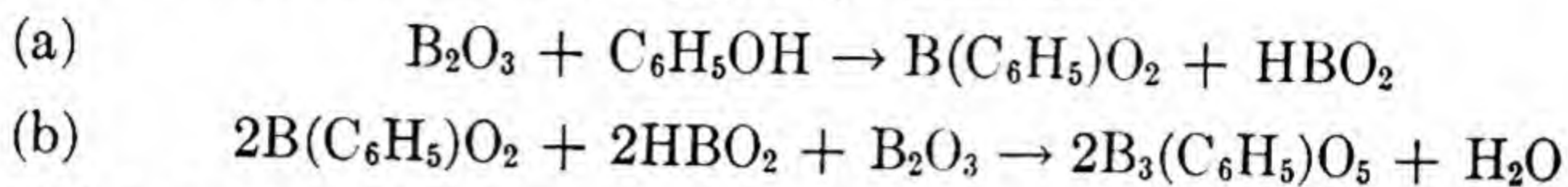
H. Schiff and E. Bechi, *Compt. Rend.*, **61**, 697 (1865)

25



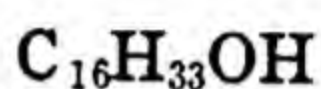
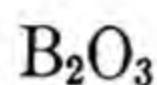
I-2798

With phenol, boron trioxide forms phenylborate in an impure condition. At a higher temperature the phenylborate reacts with boron trioxide and metaboric acid forming phenyl triborate.



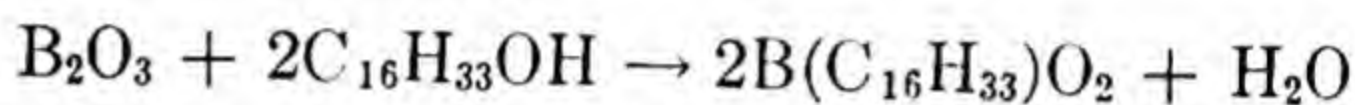
H. Schiff and E. Bechi, *Compt. Rend.*, **62**, 398 (1866)

25



I-2799

When boron trioxide is heated with cetyl alcohol, water is eliminated and boron cetylate is formed.



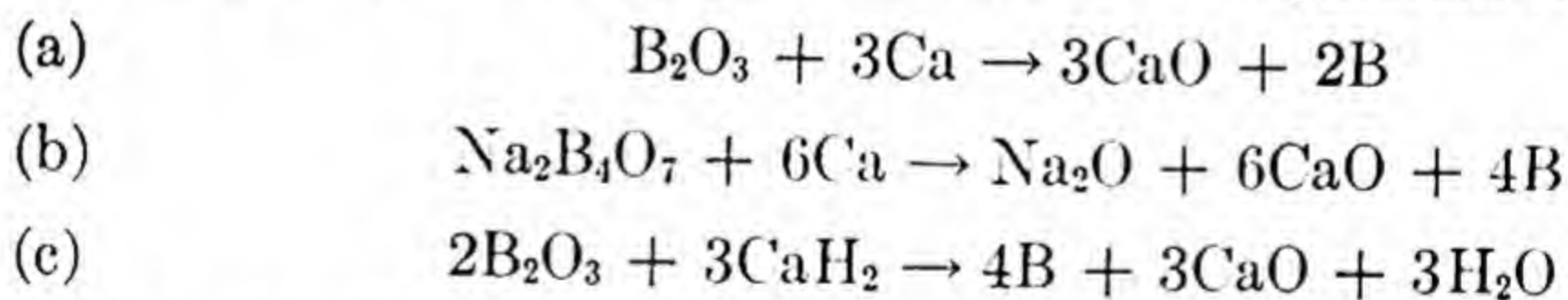
H. Schiff and E. Bechi, *Compt. Rend.*, **62**, 397 (1866)

29



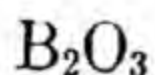
I-2800

Boron trioxide, or better anhydrous borax, may be reduced by an equivalent amount of metallic calcium or CaH_2 . The reaction is performed in a crucible, 5 to 10% excess of CaO being added to moderate the violence of the reaction. Ignition is accomplished by igniting a fuse mixture of sodium peroxide and metallic calcium with magnesium ribbon.



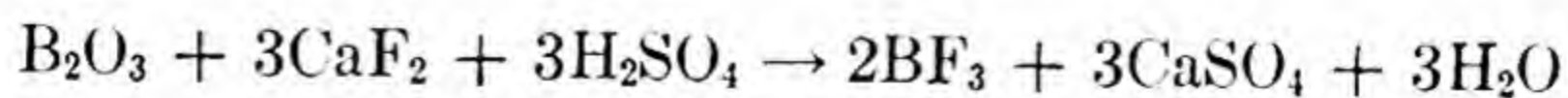
F. M. Perkin, *Trans. Far. Soc.*, **3**, 115 (1907)

85



I-2801

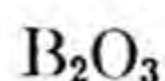
Boron trifluoride is prepared by warming a mixture of boron trioxide, calcium fluoride and 100% sulfuric acid in a resistance glass bulb in vacuo.



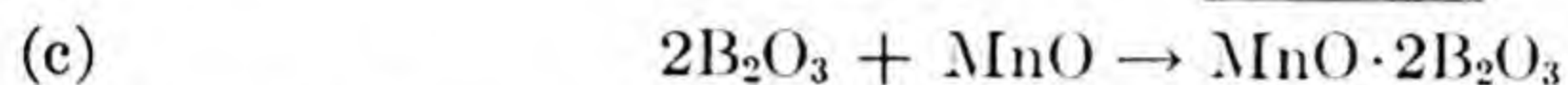
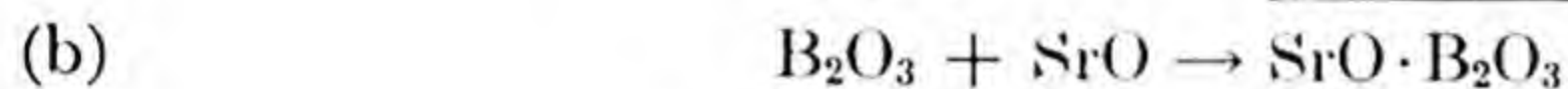
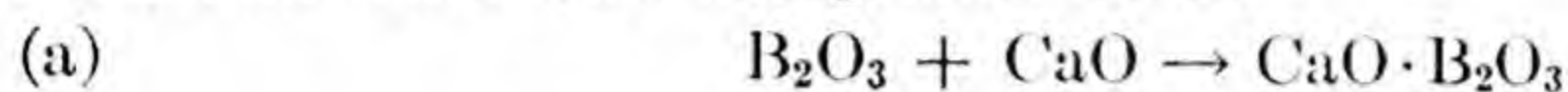
German and Booth, *J. Phys. Chem.*, **30**, 369 (1926)

Ref., H. E. Watson and K. L. Ramaswamy, *Proc. Roy. Soc. (London)*, **156A**, 137 (1936)

110

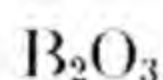
**CaO****I-2802****SrO****MnO**

By fusing together boron trioxide with calcium oxide (ratio 10:1) two layers of liquid are formed. On cooling, the lower layer will yield crystals of calcium diborate. The same type reaction occurs with strontium oxide and manganous oxide.

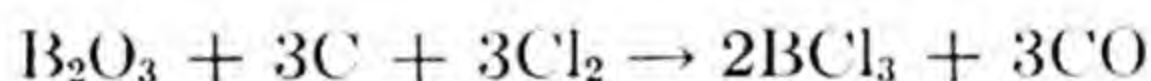


W. Guertler, Z. anorg. Chem., **40**, 225 (1904)

28

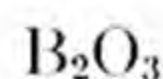
**Cl₂****I-2803****C**

Chlorine is passed over a strongly heated mixture of boron trioxide and carbon.

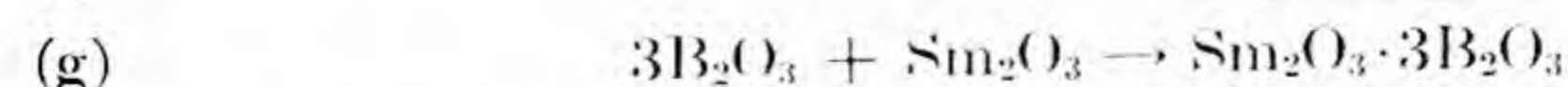
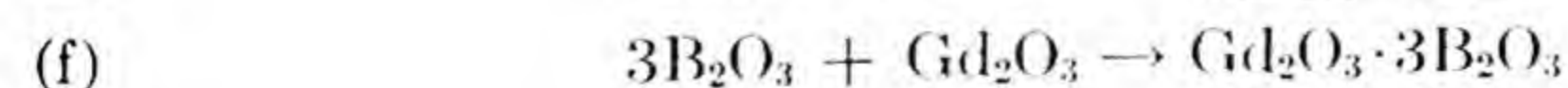
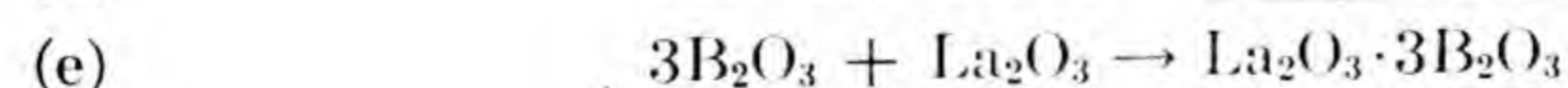
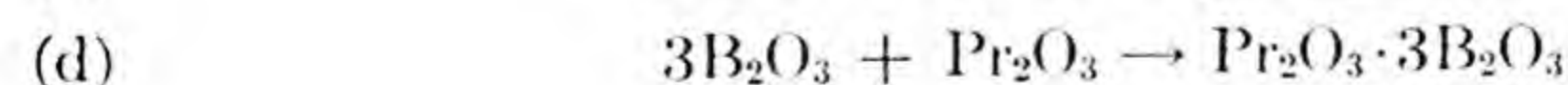
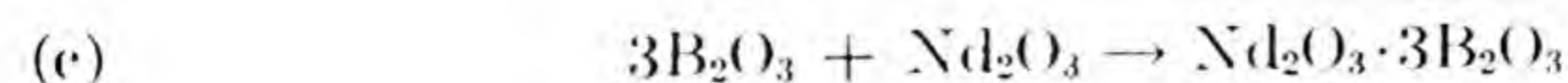
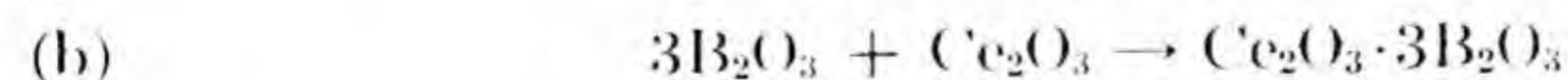


B. A. Dumas, Ann. Chim. Phys. (2) **31**, 346 (1826)

25

**CuO****I-2804**

By fusing together boron trioxide and copper oxide (ratio 10:1) two layers of liquid are formed. On cooling, the lower layer will yield crystals of copper metaborate. The same type reaction occurs with cerium oxide, neodymium oxide, praseodymium oxide, lanthanum oxide, gadolinium oxide, and samarium oxide.



W. Guertler, Z. anorg. Chem., **40**, 1225 (1904)

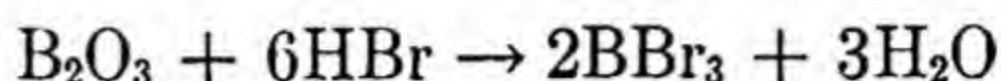
28



HBr

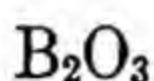
I-2805

When boron trioxide is dissolved in absolute alcohol and then treated with a current of dry hydrogen bromide, boron tribromide is formed.



J. Nickles, *Compt. Rend.*, **60**, 801 (1865)

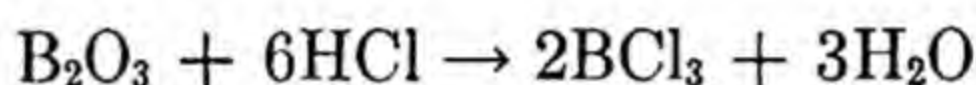
29



HCl

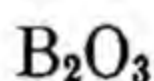
I-2806

When boron trioxide is dissolved in absolute alcohol and then treated with a current of dry hydrogen chloride, boron trichloride is formed, which remains in solution in the alcohol.



J. Nickles, *Compt. Rend.*, **60**, 800 (1865)

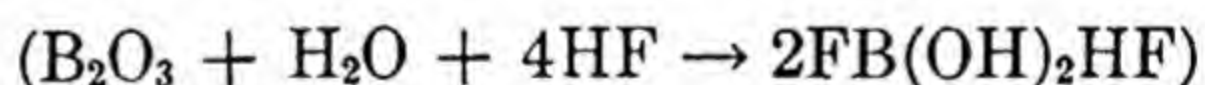
29



HF

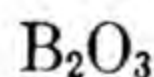
I-2807

Liquid hydrogen fluoride run into a liter copper beaker is cooled in an ice bath. After the hydrogen fluoride has been cooled to approximately the temperature of the bath, boric oxide is added. Dihydroxyfluoboric acid forms and is distilled over.



J. W. Kroeger, F. J. Sowa and J. A. Nieuwland, *J. Am. Chem. Soc.*, **59**, 965 (1937)

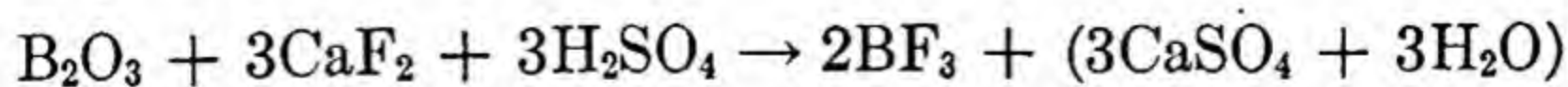
3



HF

I-2808

Boron trifluoride is prepared by dissolving fused and powdered boron trioxide in 100% sulfuric acid and adding calcium fluoride. Sulfur trioxide and hydrogen fluoride are removed by a dry ice-alcohol trap. The boron trifluoride is liquefied at the temperature of liquid air and fractionally distilled.

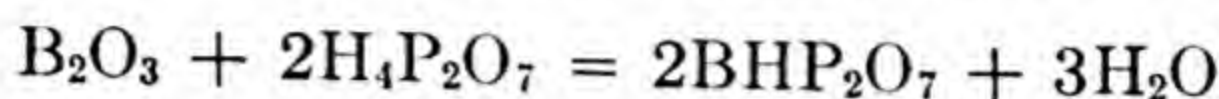


C. R. Bailey, J. B. Hale and J. W. Thompson, *Proc. Roy. Soc. (London)*, **161A**, 108 (1937)

110

H₄P₂O₇**B₂O₃****I-2809**

Boron trioxide is fused with pyrophosphoric acid to 250°.

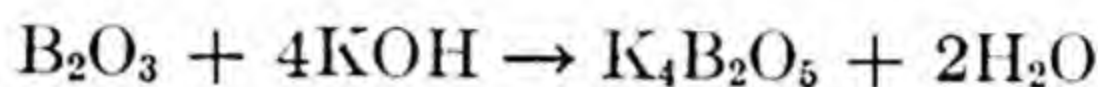


B. Levin, Brit. Pat. (1917) 116,735

25

KOH**B₂O₃****I-2810**

Boron trioxide is fused with potassium hydroxide.

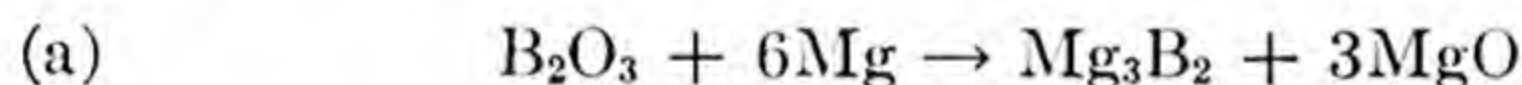


C. L. Bloxam, J. Chem. Soc. (London), **14**, 143 (1862)

25

Mg**B₂O₃****I-2811**

Boron trioxide is reduced by magnesium.

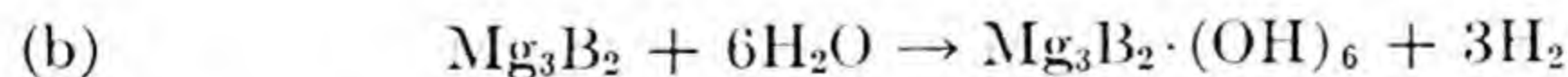
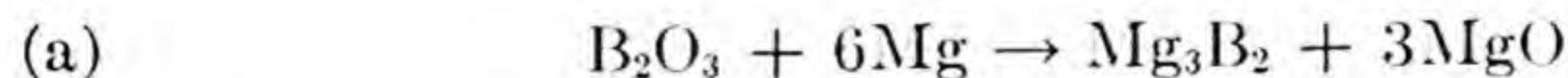


Jones and Taylor, J. Chem. Soc. (London), **39**, 213 (1881)

25

Mg**B₂O₃****I-2812**

When boron trioxide is heated with twice its weight or more of finely powdered magnesium in a tightly covered iron crucible magnesium boride is formed (a), which hydrolyzes in water at 0°C, and liberates H₂.



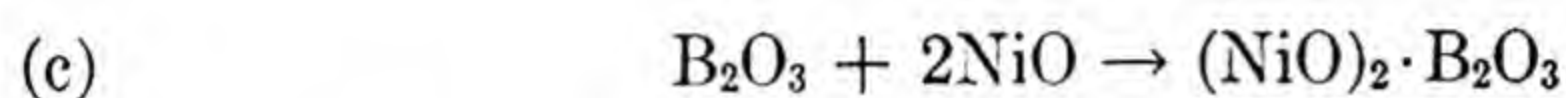
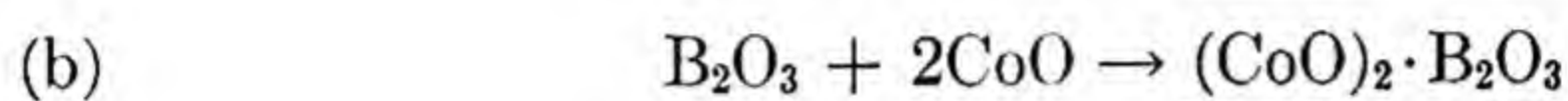
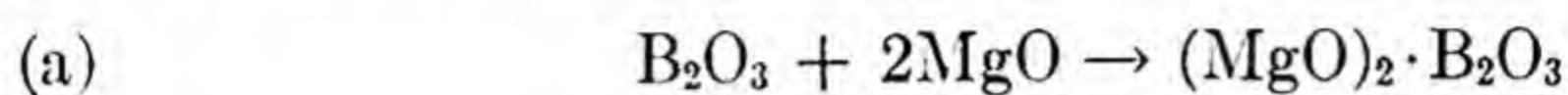
F. Jones and R. L. Taylor, J. Chem. Soc., **39**, 213 (1881)

Ref., R. C. Ray and P. C. Linha, J. Chem. Soc. (1935), p. 1694

25

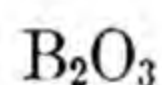
**MgO****I-2813****CoO****NiO**

By fusing together boron trioxide and magnesium oxide (ratio 10:1) two layers of liquid are formed. On cooling, the lower layer will yield crystals of magnesium pyroborate. The same type reaction occurs with cobaltous oxide and nickelous oxide.

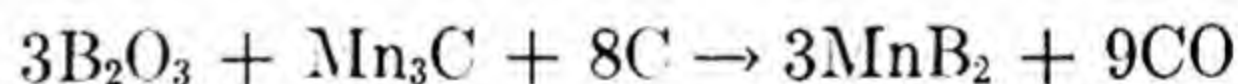


W. Guertler, *Z. anorg. Chem.*, **40**, 225 (1904)

28

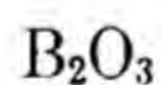
**Mn₃C + C****I-2814**

Boron trioxide mixed with carbon and manganese carbide is heated strongly in a carbide crucible.

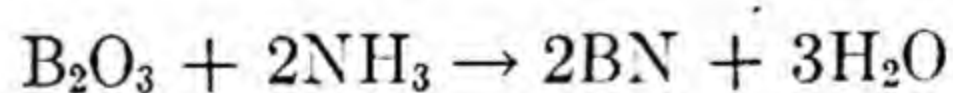


Troost and Hautefeuille, *Ann. Chim. Phys.* (5), **9**, 65 (1875)

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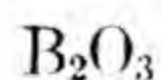
**NH₃****I-2815**

Boron trioxide is heated in a stream of ammonia.

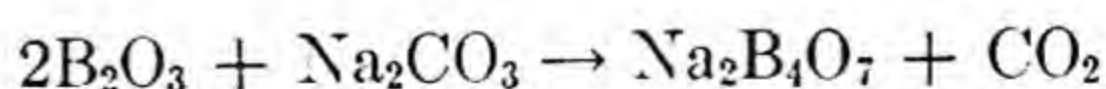


Moser and Eidmann, *Ber.*, **35**, 536 (1902)

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**Na₂CO₃****I-2816**

Boron trioxide is heated with sodium carbonate.

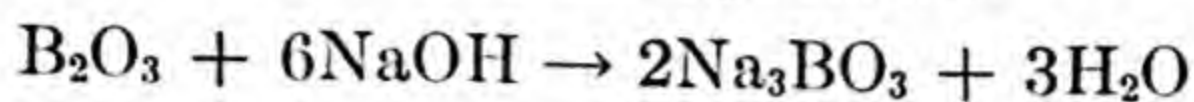


Hönig and Spitz, *Z. angew. Chem.*, **9**, 549 (1896)

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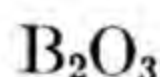
**NaOH****I-2817**

Boron trioxide is fused with sodium hydroxide.

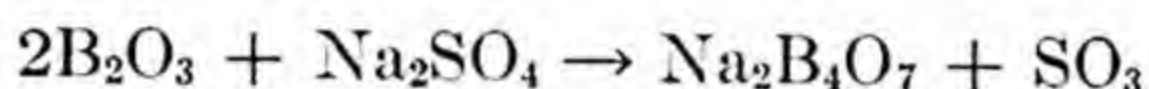


C. L. Bloxam, *J. Chem. Soc. (London)*, **14**, 143 (1862)

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**Na₂SO₄****I-2818**

By heating B_2O_3 with sodium sulfate to 500° the result will be sodium tetraborate and sulfur dioxide.

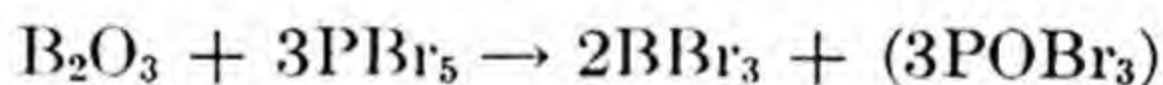


M. G. Levi and O. Garavini, *Gazz. Chim. Ital.*, **41**¹, 780 (1911)

21

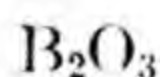
**PBr₅****I-2819**

When boric oxide and phosphorus pentabromide are heated to 140°C . in a sealed tube, boron tribromide is formed.

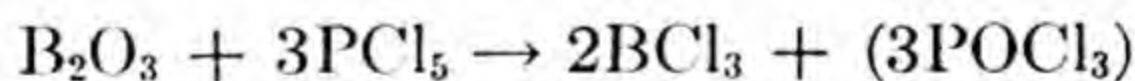


G. Gustavson,
Ref., V. Von Richter, *Ber.*, **2**, 661 (1869)

11

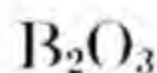
**PCl₅****I-2820**

When boric oxide and phosphorus pentachloride are heated to 140°C in a sealed tube, boron trichloride is formed.

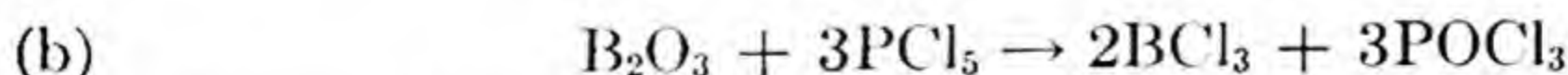


G. Gustavson,
Ref., V. Von Richter, *Ber.*, **2**, 661 (1869)

11

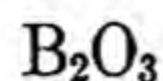
**PCl₅****I-2821**

A mixture containing boron trioxide and an excess of phosphorus pentachloride is heated to 150° in a sealed tube.



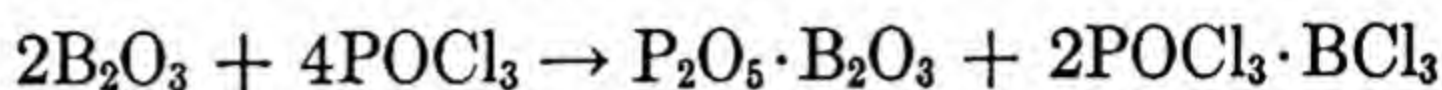
G. Gustavson, *Ann. Chim. Phys.* [5], **2**, 200 (1874)

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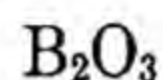
I-2822

Boric anhydride when heated with phosphorus oxychloride to 150–170°C for 8–10 hours in a sealed tube forms phosphorus pentoxide and boron trichloride which in turn react to form two double compounds.



Gustavson,
Ref., Von Richter, Ber., 4, 975 (1871)

11



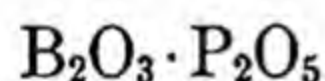
I-2823

Boron trioxide is heated with phosphorus oxychloride.



G. Gustavson, Zeit. f. Chem. [2] 7, 417 (1871)

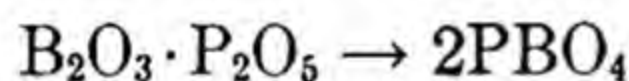
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Δ

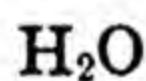
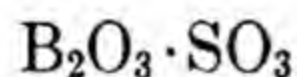
I-2824

The double compound of boric oxide and phosphorus pentoxide loses its solubility in water on being strongly heated.



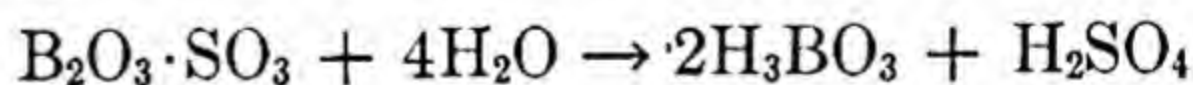
Gustavson,
Ref., Von Richter, Ber., 4, 976 (1871)

11



I-2825

The addition product of boric oxide and sulfur trioxide is decomposed by water forming boric and sulfuric acids.



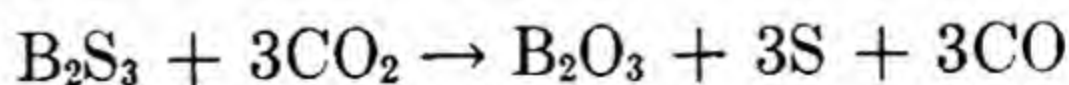
G. Gustavson, Ber., 6, 11 (1873)

11



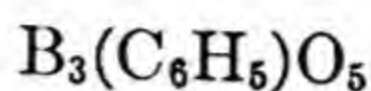
I-2826

Boron trisulfide reacts with carbon dioxide at 300°.

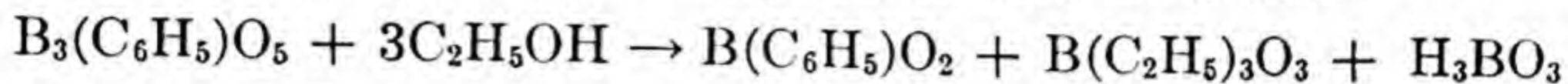


D. Costeanu, Compt. rend., 157, 934 (1913)

38

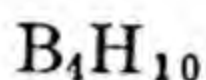
**C₂H₅OH****I-2827**

An alcoholic solution of phenyl triborate decomposes on prolonged boiling, forming phenyl borate, triethyl borate and boric acid.

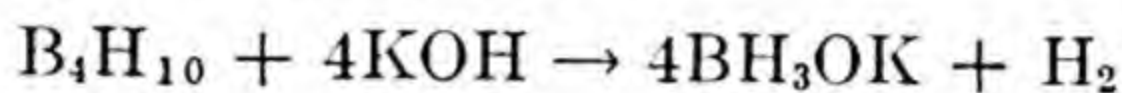


H. Schiff and E. Bechi, *Compt. Rend.*, **62**, 398 (1866)

29

**KOH****I-2828**

Crystalline potassium borate is formed through reaction of boron decahydride with potassium hydroxide.

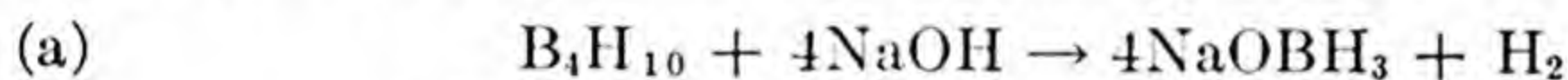


A. Stock, *Z. Elektrochem.*, **19**, 780 (1913)

86

**NaOH****I-2829**

Boron decahydride reacts with sodium hydroxide.

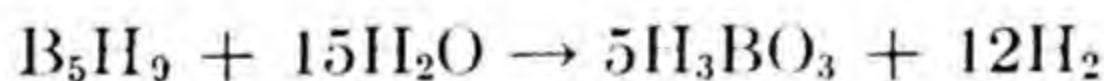


Stock and Massenez, *Ber.*, **45**, 3539 (1912)

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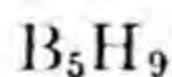
**H₂O****I-2830**

Boron nonahydride reacts with water when heated in a sealed tube to 90°.

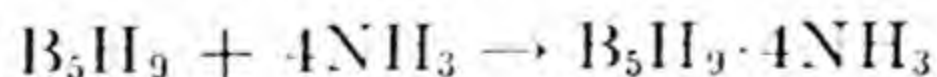


Stork and Kuss, *Ber.*, **56**, 802 (1923)

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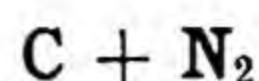
**NH₃****I-2831**

Boron nonahydride absorbs ammonia when treated with a large excess.



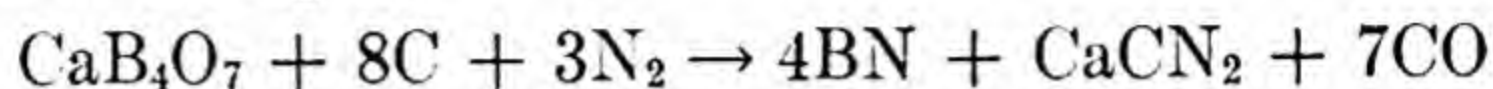
Stock and Siecke, *Ber.*, **57B**, 562 (1924)

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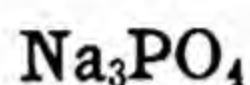
I-2832

Calcium tetraborate is mixed with charcoal and heated strongly in an atmosphere of nitrogen.



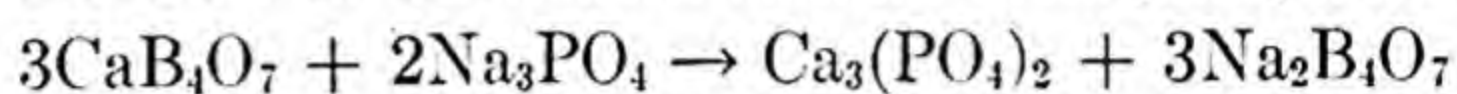
Stahler and Elbert, Ber., **46**, 2060 (1913)

25



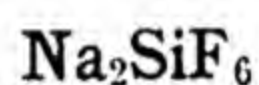
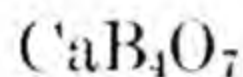
I-2833

Calcium tetraborate is fused with sodium orthophosphate.



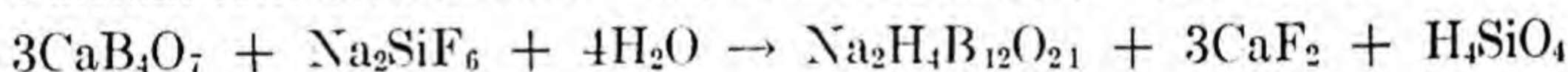
Schuster and Wilhelmy, Ger. Pat 94050 (1897)

25



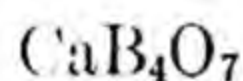
I-2834

Calcium tetraborate reacts with sodium fluosilicate and water.



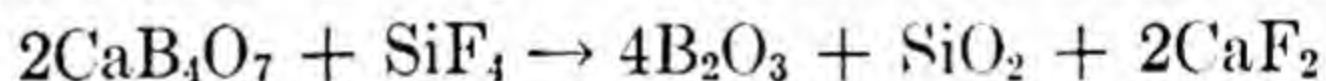
Rickmann and Rappe, Ger. Pat. 98759 (1898)

25



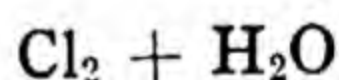
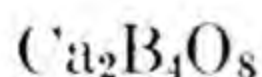
I-2835

Calcium tetraborate is decomposed by silicon tetrafluoride.



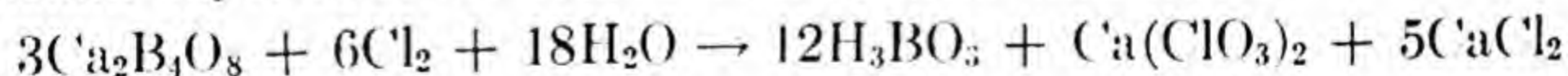
Rickmann and Rappe, Ger. Pat. 96,196 (1897)

25



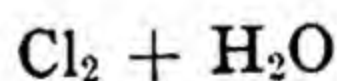
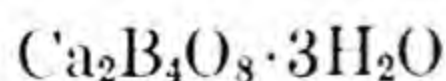
I-2836

Calcium oxytetraborate reacts with chlorine and water.



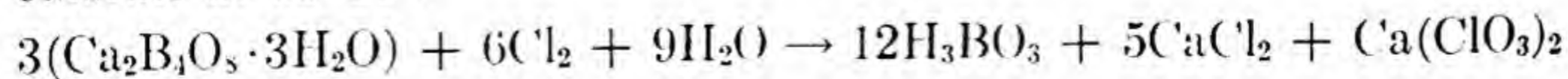
C. C. Moore, Brit. Pat. 20,384 (1899)

25



I-2837

Natural calcium oxytetraborate is suspended in water and treated with chlorine at 60–80°.

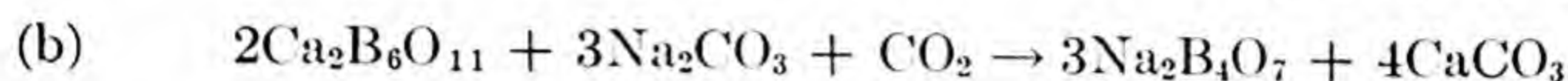
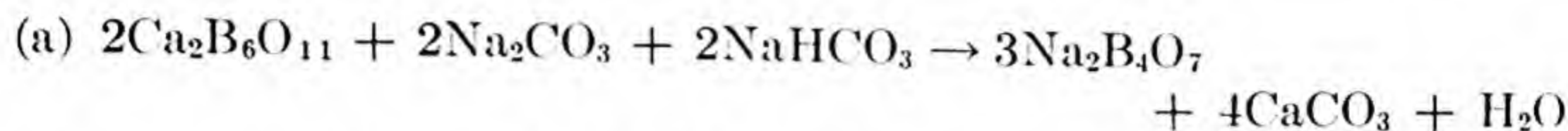


Moore, Ger. Pat. 118,073 (1900)

25

Na₂CO₃Ca₂B₆O₁₁**I-2838**

Borax is obtained from calcined colemanite or borate by processes based on the following reactions.



Burton G. Wood, Chem. Met. Eng., **30**, 976 (1924)

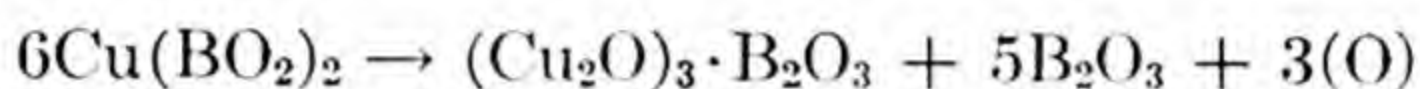
44

Cu(BO₂)₂

Δ

I-2839

By heating cupric metaborate at a temperature of 950°, brown colored crystals of cuprous sesqui-borate are obtained.



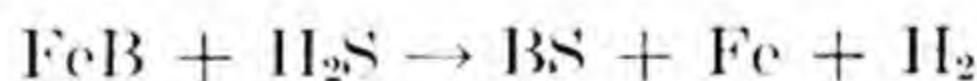
W. Guertler, Z. anorg. Chem., **38**, 456 (1904)

28

FeB

H₂S**I-2840**

Iron boride, containing about 20% B, is pulverized and heated in a closed crucible to 300–400°C. Then gaseous hydrogen sulfide is led over it (must be absolutely dry). Then the whole mass is cooled and the sulfur separated from the tiny crystals of boron sulfide by leaching with carbon disulfide.

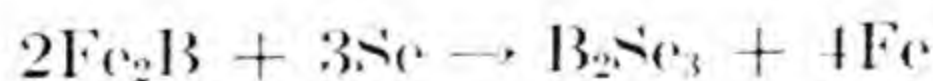


J. Hoffmann, Z. angew. Chem., **19**, 1362 (1906)

34

Fe₂B**Se****I-2841**

Ferrie boride is reduced by heating with selenium.



J. Hoffmann, Chem. Ztg., **35**, 713

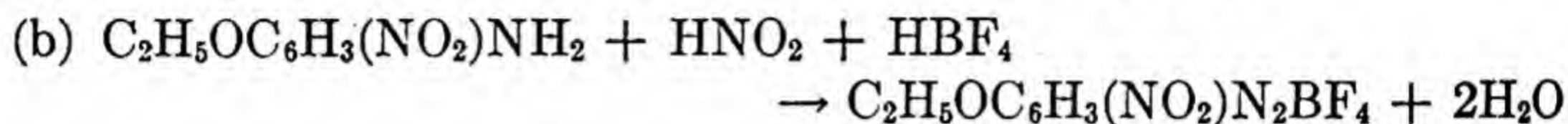
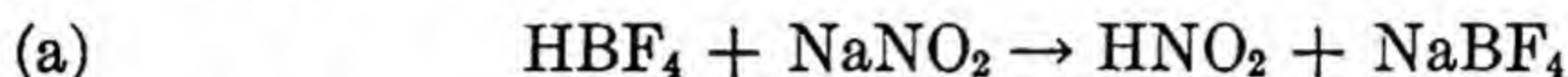
25



I-2842

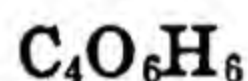
4-amino-3-nitrophenetole

The addition of a cold solution of sodium nitrite to a well-cooled mixture of fluoboric acid and 4-amino-3-nitrophenetole with stirring precipitates the diazonium fluoborate.



Demers and Lynn, *J. Am. Pharm. A.*, **30**, 627 (1941)

112



I-2843

Polarimetric measurements reveal the existence of a boro-ditartaric acid in solutions of metaboric and tartaric acid:



M. Darmais, *J. Chim. phys.*, **23**, 130 (1926)

Ref., J. L. Delsal, *J. Chim. phys.*, **35**, 350 (1938)

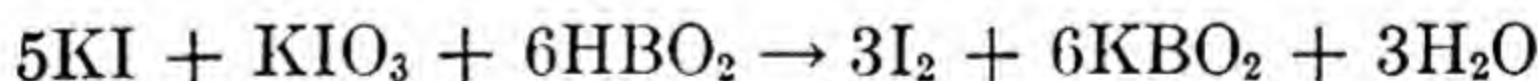
69



I-2844



Metaboric acid reacts with potassium iodate and iodide in the presence of mannite, liberating an amount of iodine equivalent to amount of boron present.



L. C. Jones, *Am. J. Sci.*, **158**, 127 (1899)

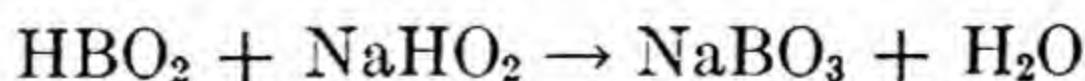
Ref., *J. Am. Chem. Soc.*, **21**, 101 (1899)

Ref., *Rev. Am. Chem. J.*, **5**, 101 (1899)

1
7

I-2845

Solutions of metaboric acid and sodium hydrogen peroxide react near 0°.

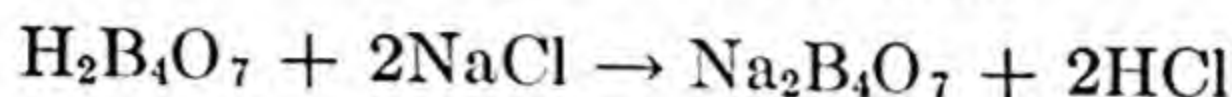


H. J. Calvert, *Ber.*, **38**, 513 (1901)

25

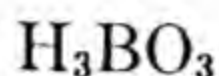
**NaCl****I-2846**

Under ordinary conditions tetraboric acid reacts with sodium chloride to give sodium tetraborate and hydrochloric acid.

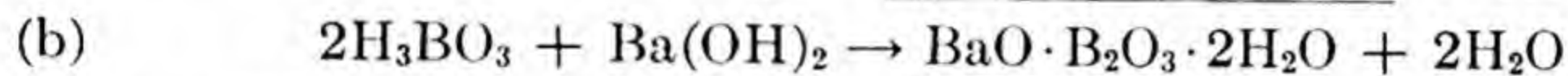
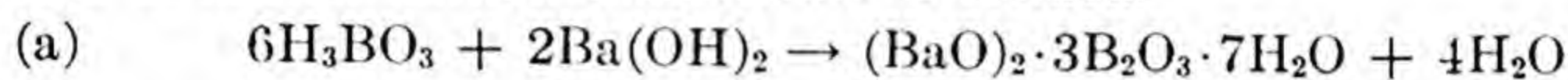


M. G. Levi and S. Castellani, *Gazz. chim. ital.*, **40**, 155 (1910)

21

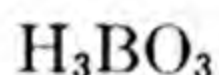
**Ba(OH)₂****I-2847**

By adding a solution of boric acid to an excess of baryta water an amorphous precipitate of barium sesquiborate is obtained. When the mixture is heated barium monoborate is formed.



A. Atterberg, *Z. anorg. Chem.*, **48**, 367 (1906)

28

**C****I-2848**

Crystalline boron carbide, the hardest artificial abrasive known, is produced from boric acid and carbon.



R. M. Curts, *Chem. Ind.*, **47**, 372 (1940)

84

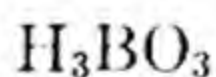
**CaCN₂****I-2849**

Boric acid is heated strongly with calcium cyanamide.



W. Kroll, *Z. anorg. Chem.*, **102**, 1 (1918)

25

**CaCl₂****I-2850**

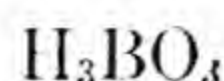
The double oxide of calcium and boron was obtained when boric acid was fused with calcium chloride in the presence of sodium and potassium chloride.



Ditte, *Compt. rend.*, **80**, 490, 561 (1875)

Ref., G. W. Sargent, *J. Am. Chem. Soc.*, **21**, 861 (1899)

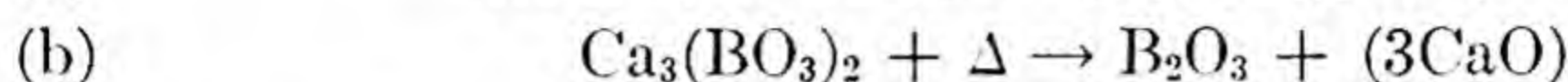
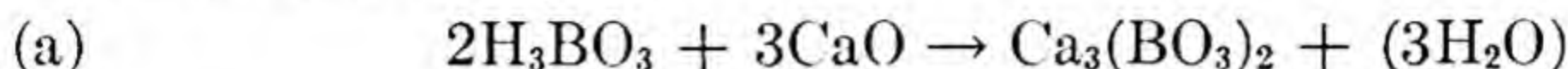
1



CaO

I-2851

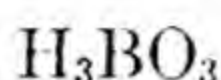
Boron trioxide is formed when boric acid solution is evaporated to dryness with lime and ignited.



Gooch, Am. Chem. J., **9**, 23 (1887)

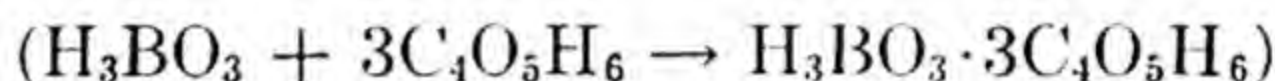
Ref., G. W. Sargent, J. Am. Chem. Soc., **21**, 862 (1899)

1

C₄O₅H₆

I-2852

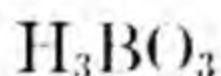
Orthoboric acid forms a levo-rotating complex compound with malic acid:



M. Darmois, J. Chim. phys., **23**, 130 (1926)

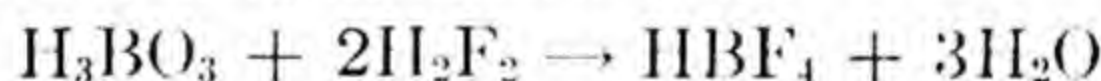
Ref., J. L. Delsal, *ibid.*, **35**, 350 (1938)

69

H₂F₂

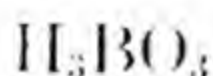
I-2853

Fluoboric acid can be prepared by adding boric acid to a concentrated (48 per cent) solution of hydrofluoric acid.



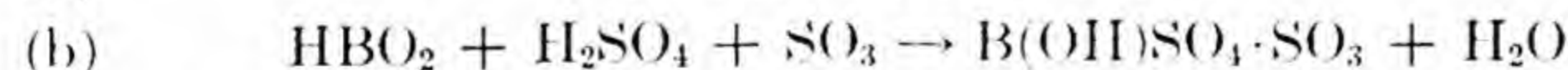
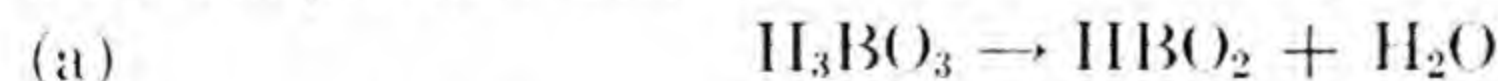
Willard R. Line and Paul W. Aradine, Ind. Eng. Chem., Anal. Ed., **9**, 60 (1937)

44

H₂SO₄ + SO₃

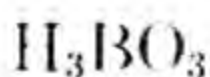
I-2854

Boric acid when heated with fuming sulfuric acid forms a sulfur trioxide addition product with the compound first produced.



C. Schultz-Sellack, Ber., **4**, 15 (1871)

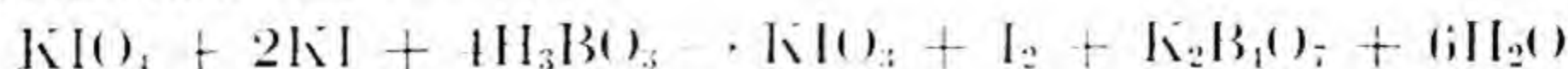
11

KIO₄

I-2855

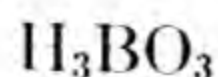
KI

Boric acid, periodates, and iodides react to give iodates, iodine, water, and potassium tetraborate.



H. H. Willard and L. H. Greathouse, J. Am. Chem. Soc., **60**, 2869 (1938)

3

K₂WO₄·2H₂O**I-2856**

Klein was the first to discover and describe the borotungstates. He reacted boric acid with alkaline tungstates to obtain two series of compounds. The formulas which he ascribed to them, however, are in error.

(a) $\text{B}_2\text{O}_3 \cdot 14\text{WO}_3 \cdot 3\text{K}_2\text{O} + \text{aq.}$

(b) $\text{B}_2\text{O}_3 \cdot 9\text{WO}_3 \cdot 2\text{H}_2\text{O} + \text{aq.}$ (etc.)

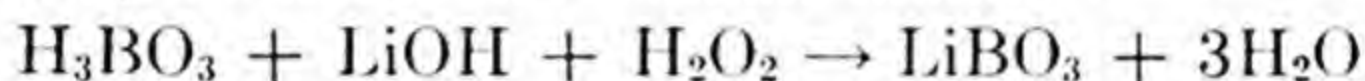
D. Klein, *Ann. chim. phys.* (5), **28**, 370 (1883)

Ref., H. Copaux, *Compt. rend.*, **147**, 973 (1908)

38

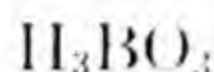
**LiOH****I-2857****H₂O₂**

Hydrogen peroxide changes a mixture of lithium hydroxide and orthoboric acid to lithium perborate and water. The perborates of K, Rb, Cs, and NH₄ may be made in a similar manner.

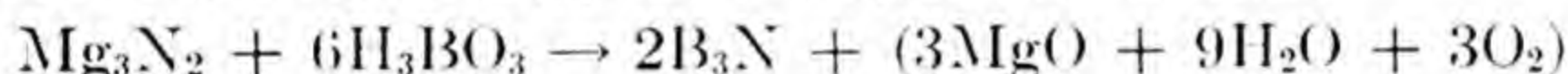


O. T. Christensen, *Översigt Kong. Dan. Vid. Sel. Forh.*, (1904), p. 409

10

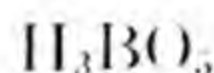
**Mg₃N₂****I-2858**

Boric acid is heated strongly with magnesium nitride.



W. Kroll, *Z. anorg. Chem.*, **102**, 1 (1918)

25

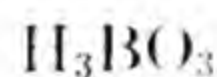
**Mn₃C****I-2859**

Manganese carbide reacts with boric acid when heated, to form small gray violet crystals of manganese boride.



A. Henninger, *Ber. (I)*, **9**, 190 (1876)

26

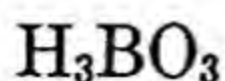
**NH₃****I-2860****NaCl**

A solution containing boric acid and sodium chloride reacts with ammonia.



Dresel and Lenhoff, *Brit. Pat.* 11,905 (1891)

25



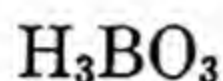
I-2861

By heating boric acid with an excess of sodium carbonate, sodium tetraborate, carbon dioxide and water will form.



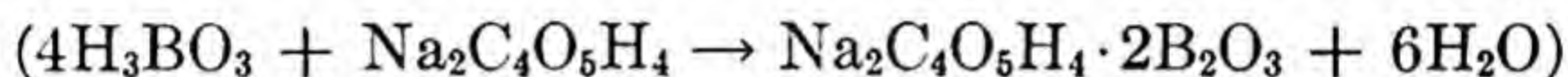
M. G. Levi and S. Castellani, *Gazz. Chim. Ital.*, **40**¹, 138 (1910)

21



I-2862

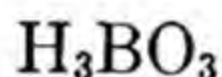
A polarimetric study of the system: boric acid-sodium malate reveals the formation of a dextro complex compound, stable in solution only.



M. Darmois, *J. Chim. phys.*, **23**, 130 (1926)

Ref., J. L. Delsal, *J. Chim. phys.*, **35**, 350 (1938)

69



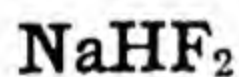
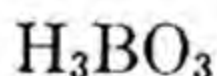
I-2863

On heating boric acid with sodium chloride the result will be hydrochloric acid, sodium tetraborate and water.



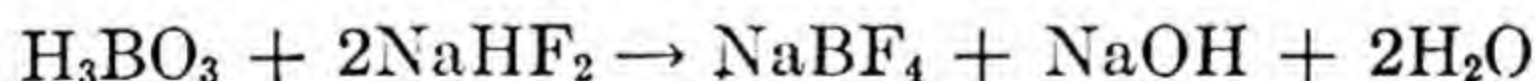
M. G. Levi and S. Castellani; *Gazz. Chim. Ital.*, **40**¹, 151 (1910)

21



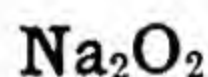
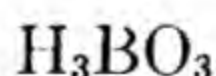
I-2864

Solutions of boric acid and sodium hydrogen fluoride react.



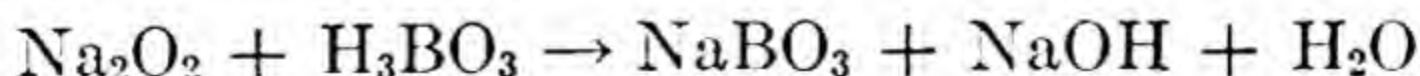
W. C. Zeise, *Scheiffer's Journal*, **32**, 306 (1821)

25



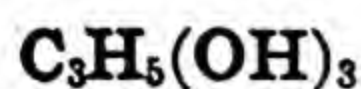
I-2865

Orthoboric acid treated with sodium peroxide yields sodium perborate, sodium hydroxide and water.



O. T. Christensen, *Översigt Kong. Dan. Vid. Sel. Forh.*, 1904, p. 403

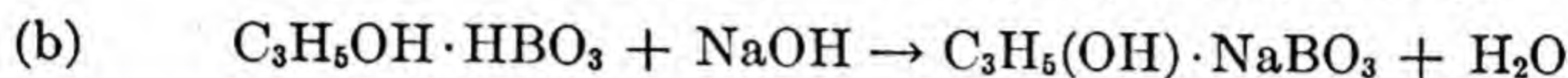
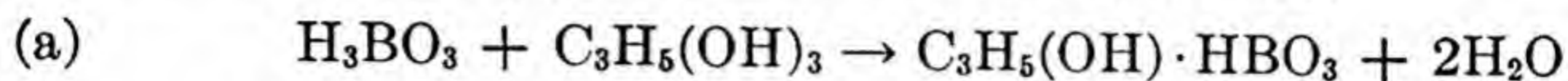
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I-2866

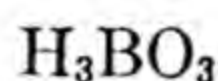


When glycerol is added to boric acid and then the acid is titrated against sodium hydroxide, glycerol-sodium borate is formed.



Mellon and Morris, Ind. Eng. Chem., **17**, 145 (1925)

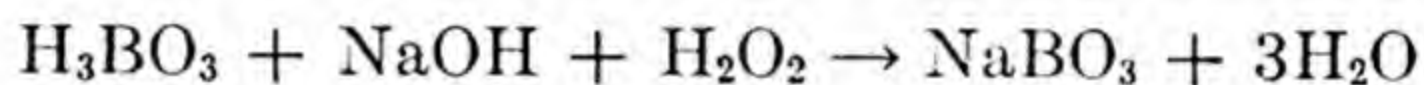
23



I-2867

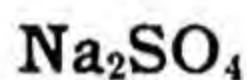
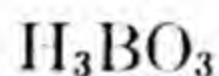


A mixture of orthoboric acid and sodium hydroxide is changed by hydrogen peroxide into sodium perborate and water.



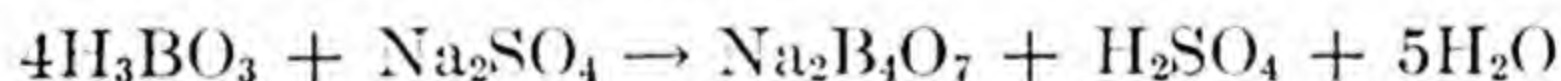
O. T. Christensen, Översigt Kong. Dan. Vid. Sel. Forh., (1904), p. 401

10



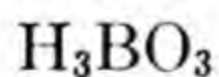
I-2868

On heating boric acid with sodium sulfate the result will be sodium tetraborate, sulfuric acid and water.



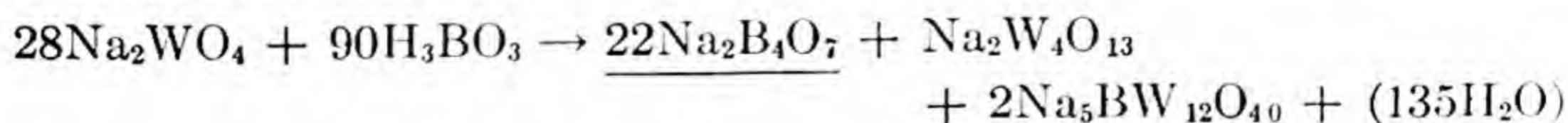
M. G. Levi and O. Garavini, Gazz. Chim. Ital., **41**, 777 (1911)

21



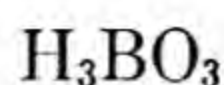
I-2869

When one part of sodium tungstate and $1\frac{1}{2}$ parts of boric acid are treated with just enough of water to dissolve them at boiling and the solution is allowed to stand, sodium tetraborate, sodium tetratungstate and a borotungstate are obtained.



H. Copaux, Compt. rend., **147**, 974 (1908)

38



Δ

I-2870

Boron oxide can be prepared by fusing boric acid.



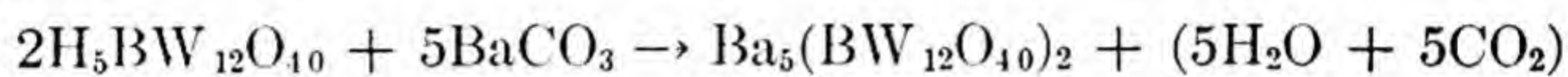
S. A. Tucker and H. R. Moody, *J. Chem. Soc. (London)*, **81**, 15 (1902)

102

BaCO₃

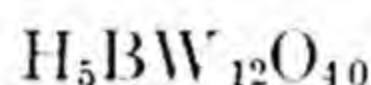
I-2871

Barium carbonate forms a precipitate of barium borotungstate when added to solutions of borotungstic acid. The acid may be regenerated from the salt thus formed by acidifying with sulfuric acid in the usual manner.



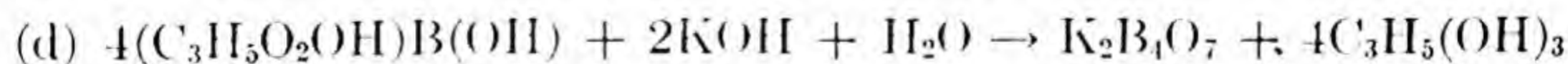
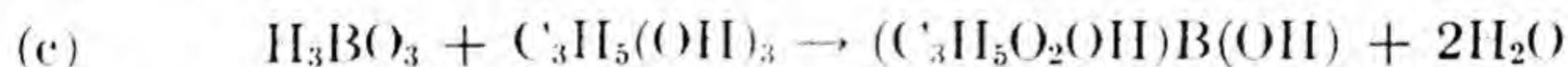
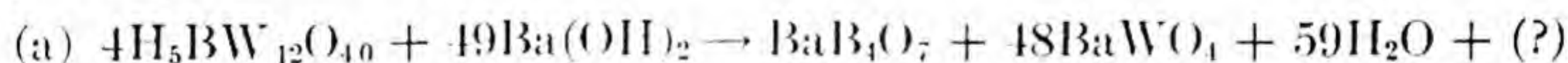
H. Copaux, *Compt. rend.*, **147**, 974 (1908)

38

Ba(OH)₂

I-2872

Borotungstic acid is dissolved in water and treated with boiling baryta water to split it into a mixture of barium tungstate and barium borate (a). The mixture is exactly neutralized with hydrochloric acid in the presence of methyl orange to liberate the boric acid (b). Glycerine is then added and the product titrated with potassium hydroxide using phenolphthalein as indicator.



H. Copaux, *Compt. rend.*, **147**, 976 (1908)

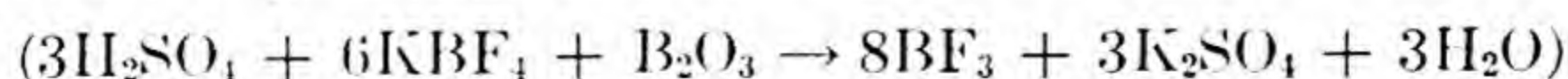
38

H₂SO₄

I-2873

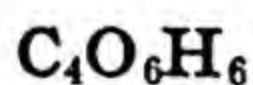
B₂O₃

Boron fluoride is prepared by the action of hot concentrated sulfuric acid on a mixture of potassium fluoborate and boric oxide.



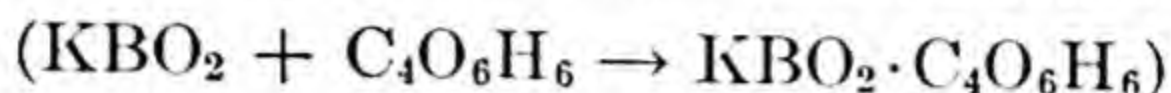
E. L. Gamble, O. Gilmont and J. I. Stiff, *J. Am. Chem. Soc.*, **62**, 1257 (1940)

3



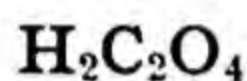
I-2874

When a solution of potassium metaborate is mixed with tartaric acid, the curve of optical rotary powers shows formation of a 1:1 complex:



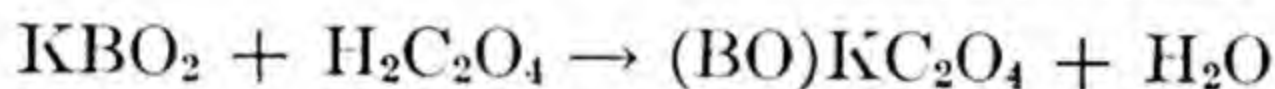
Yeu Ki Heng, *J. Chim. phys.*, **33**, 356 (1936)

69



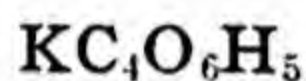
I-2875

When molecular portions of potassium metaborate and oxalic acid are boiled together in moderately strong aqueous solution for 15 or 20 minutes, potassium boro-oxalate and water are formed.



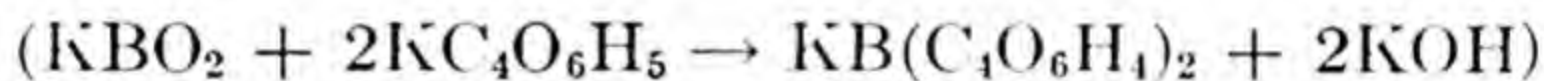
E. A. Werner, *J. Chem. Soc. (London)*, **85**, 1450 (1904)

102



I-2876

A complex salt separates from solutions of potassium metaborate and potassium hydrogen tartrate.



Lowry, *J. Chem. Soc.*, **131**, 2853 (1929)

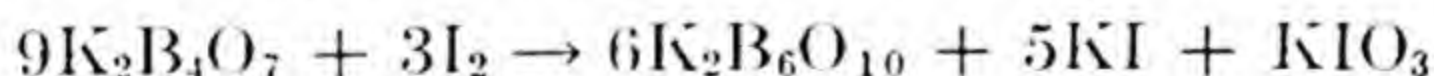
Ref., J. L. Delsal, *J. chim. phys.*, **35**, 350 (1938)

69



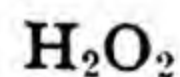
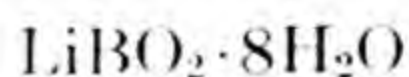
I-2877

A potassium tetraborate solution absorbs iodine.



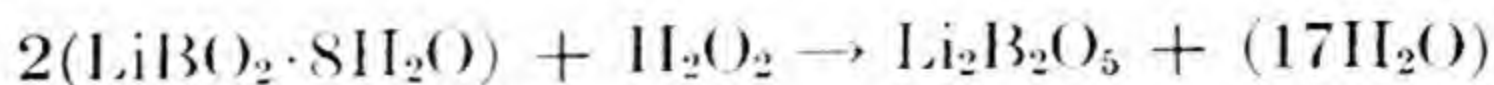
H. Schiff, *Ann. Suppl.*, **5**, 175 (1867)

20



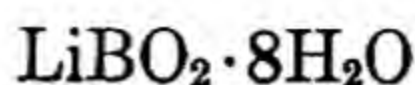
I-2878

Lithium metaborate solution is treated with an excess of hydrogen peroxide at 0°. When absolute alcohol is added and the solution evaporated in vacuo at 40°, a white amorphous powder of lithium perborate is formed.



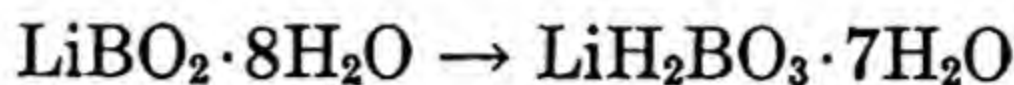
R. B. Lowy, *Bull. Soc. Chim. (Roumania)*, **5**, 81 (1923)

2

 Δ

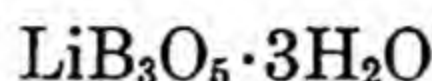
I-2879

At 160° hydrated lithium metaborate forms lithium dihydrogen orthoborate.



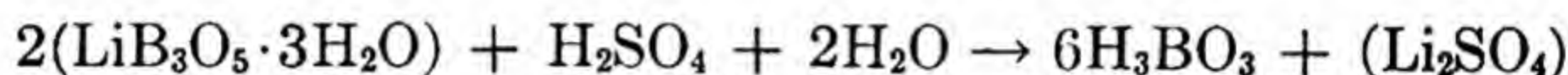
A. Reischle, Z. anorg. Chem., **4**, 166 (1893)

2

 H_2SO_4

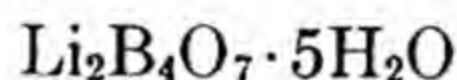
I-2880

Sulfuric acid separates boric acid from a dilute solution of lithium triborate.



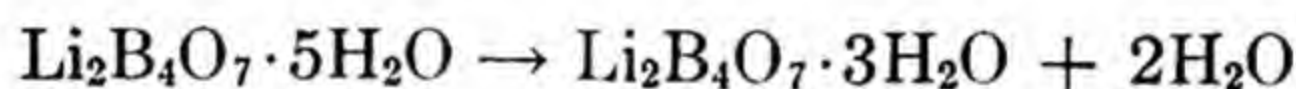
F. Filsinger, Arch. Pharm., [3], **8**, 198

2

 Δ

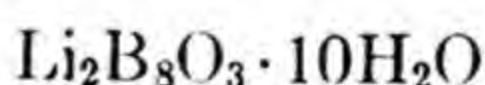
I-2881

At 200° lithium tetraborate loses two molecules of water of crystallization.



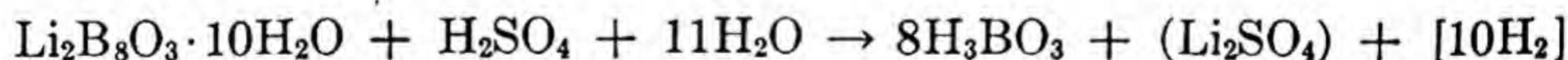
F. Filsinger, Arch. Pharm., [3], **8**, 198

2

 H_2SO_4

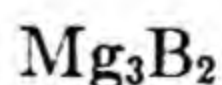
I-2882

Sulfuric acid separates boric acid from a dilute solution of lithium octaborate.



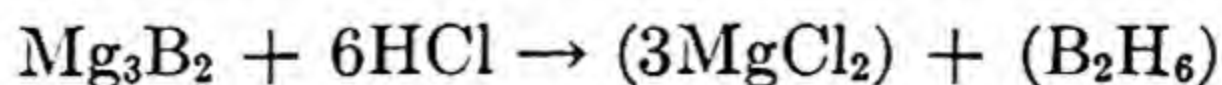
F. Filsinger, Arch. Pharm. [3] **8**, 198

2

 HCl

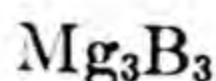
I-2883

Hydrochloric acid (or nitric acid) reacts upon magnesium boride to form boron hexahydride. The hydride is an inflammable gas.



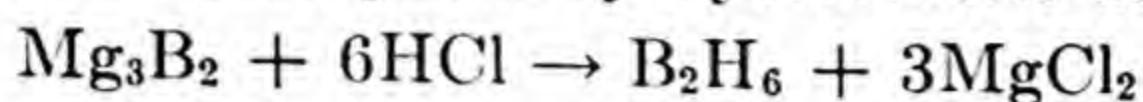
F. Jones, J. Chem. Soc., (London), **35**, 42 (1879)

91



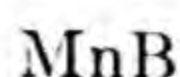
HCl **I-2884**

Magnesium boride is decomposed by hydrochloric acid.



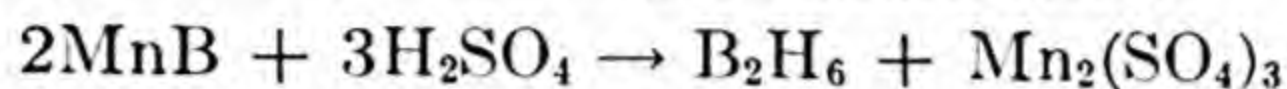
Stock and Massenez, Ber., **45**, 3539 (1912)

25



H₂SO₄ **I-2885**

Boromanganese is treated with dilute sulfuric acid.



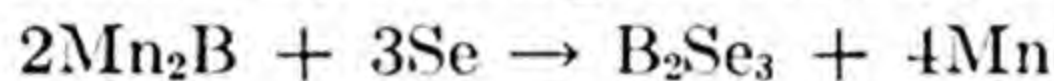
J. Hoffmann, Chem. Ztg., **35**, 265 (1911)

25



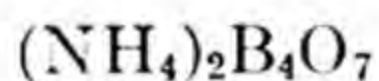
Se **I-2886**

Mangano boron is reduced by heating with selenium.



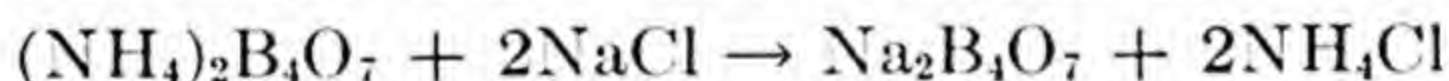
J. Hoffmann, Chem. Ztg., **35**, 713 (1911)

25



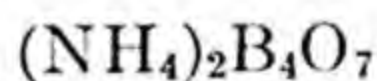
NaCl **I-2887**

Ammonium tetraborate reacts with a solution of sodium chloride.



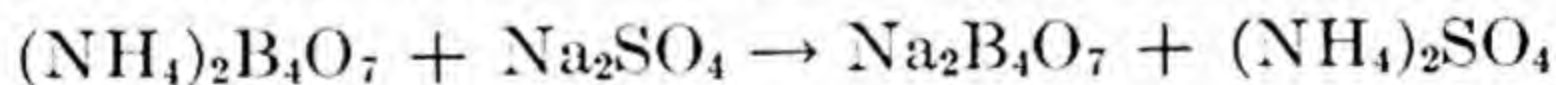
Sborgi and Franco, Gazz. Chim. Ital., **51**, 1 (1921)

21



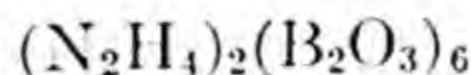
Na₂SO₄ **I-2888**

Ammonium tetraborate reacts with sodium sulfate.



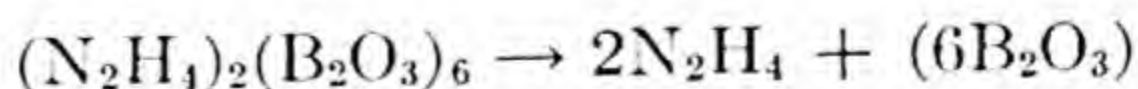
Sborgi and Bovalini, Gazz. Chim. Ital., **54**, 919 (1924)

21



Δ **I-2889**

Free hydrazine is obtained when dry hydrazine borate is heated above 260°.



Dschawachow, J. Russ. Phys. Chem. Soc., **34**, 227 (1902); Chem. Zentr., I, 1393 (1902)

Ref., Hale and Shetterly, J. Am. Chem. Soc., **33**, 1072 (1911)

1



Δ

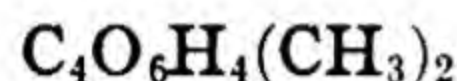
I-2890

Sodium fluoborate is decomposed by heat.



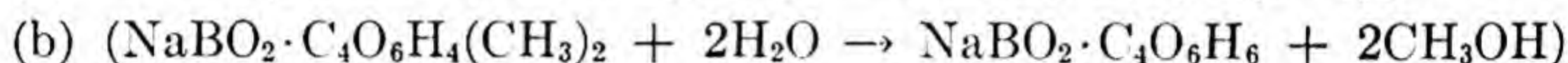
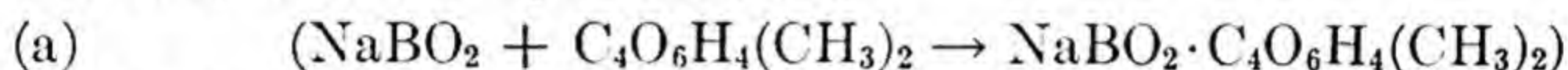
J. J. Berzelius, Stockholm Akad. Handl. p. 284 (1823) and p. 46 (1824)

25



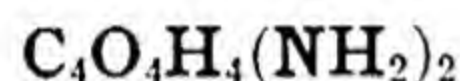
I-2891

When sodium metaborate and dimethyltartrate solutions are mixed together, an unstable complex, (a), is formed, which decomposes spontaneously into a simpler one, (b).



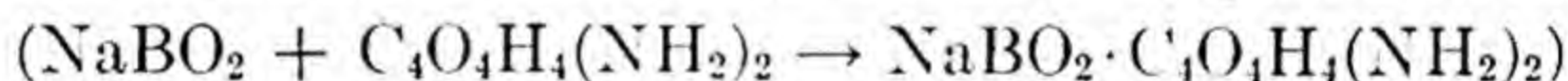
Yeu Ki Heng, J. Chim. phys., **33**, 356 (1936)

69



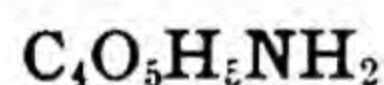
I-2892

In solution, sodium metaborate forms a stable complex with tartramide:



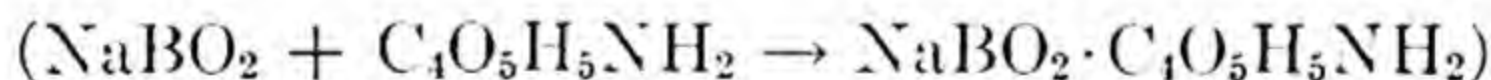
Yeu Ki Heng, J. Chim. phys., **33**, 356 (1936)

69



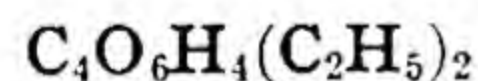
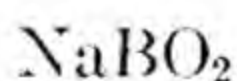
I-2893

Tartramic acid forms an optically active complex with sodium metaborate.



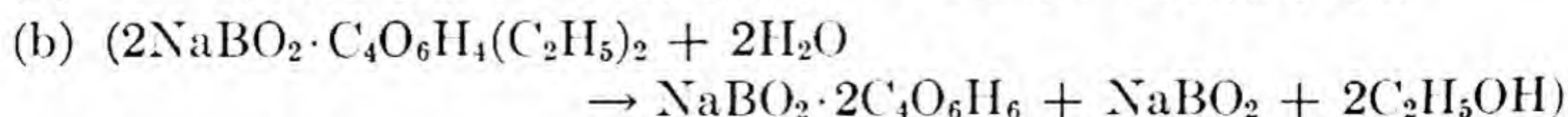
Yeu Ki Heng, J. Chim. phys., **33**, 356 (1936)

69



I-2894

In solution, sodium metaborate and diethyl tartrate give a levo complex which decomposes immediately into a dextro complex:



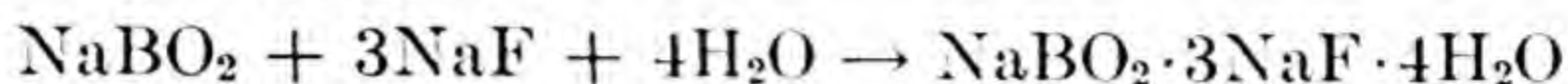
E. Darmois, J. Chim. phys., **27**, 182 (1930)

Ref., Yeu Ki Heng, J. Chim. phys., **33**, 356 (1936)

69

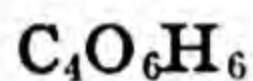
**NaF****I-2895**

When one mole of sodium metaborate and three moles of sodium fluoride are dissolved together, and the solution slowly concentrated, a crystalline double salt is formed.

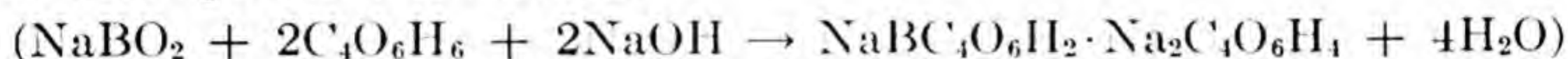


A. Basarow, Ber., **7**, 1121 (1874)

11

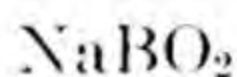
**NaOH****I-2896**

The electrometric titration of a solution of sodium metaborate and tartaric acid by sodium or ammonium hydroxide reveals the existence of a complex salt in solution.

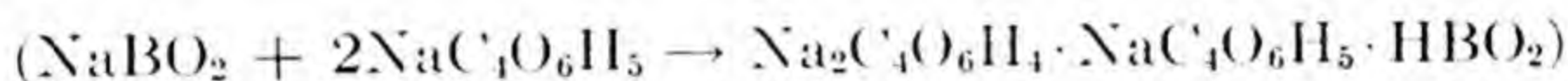


J. L. Delsal, J. chim. phys., **35**, 350 (1938)

69

**NaOH****I-2897**

Sodium hydrogen tartrate and sodium metaborate form a complex salt.



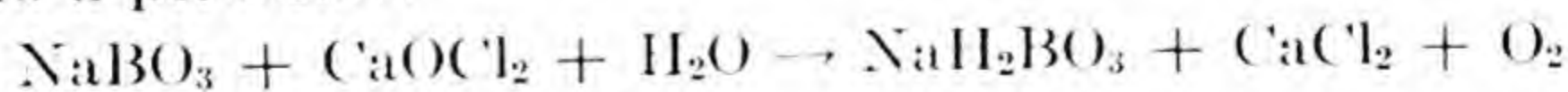
Britton and Jackson, J. Chem. Soc., (London), 1002 (1934)

Ref., J. L. Delsal, J. Chim. phys., **35**, 350 (1938)

69

**CaOCl₂****I-2898**

Oxygen is evolved when a saturated solution of bleaching powder is added to a perborate.



H. Trickett, Analyst, **43**, 89 (1920)

40

**H₂O****I-2899**

Sodium perborate reacts with water at 25°.



H. J. Calvert, Ber., **38**, 513 (1901)

25

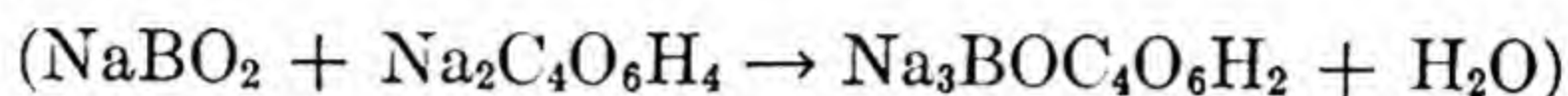


NaOH

I-2900

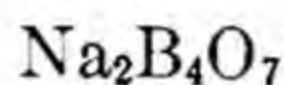


The electrometric titration curves of a solution of sodium metaborate and tartrate with sodium hydroxide show a maximum corresponding to a complex salt:



J. L. Delsal, *J. Chim. phys.*, **35**, 350 (1938)

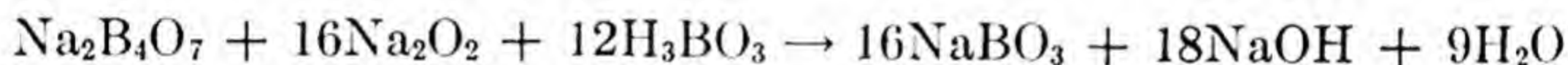
69

H₃BO₃

I-2901



Grind together 38.2 g borax, 74.4 g boric acid and 31.2 g sodium peroxide and let stand in an open vessel for 24 hours. Then under rapid stirring drop the mixture slowly in 200 cc water and do not let the temperature rise above 40°C. Now stir in 200 cc conc. sodium chloride solution and filter the sodium perborate off after 15 minutes and dry over phosphorus pentoxide.



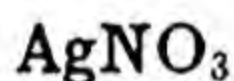
E. Bosshard and K. Zwicky, *Z. angew. Chem.*, **25**, 938 (1912)

34

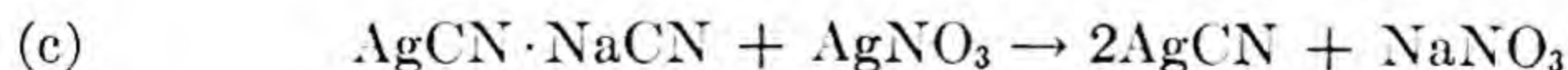
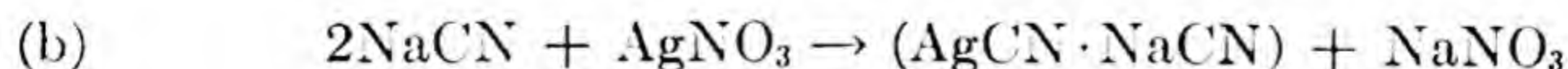
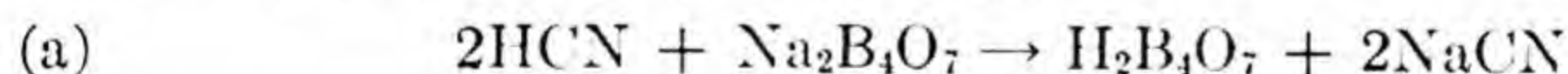


HCN

I-2902



Hydrocyanic acid may be determined by treating a dilute solution with a 3% borax solution and titrating with silver nitrate or iodine until a permanent cloud or yellow color appears.



Guerin, *J. Pharm. Chim.*, (6), **22**, 433 (1905)

Ref., *J. Am. Chem. Soc.*, **28**, 1771 (1906)

1

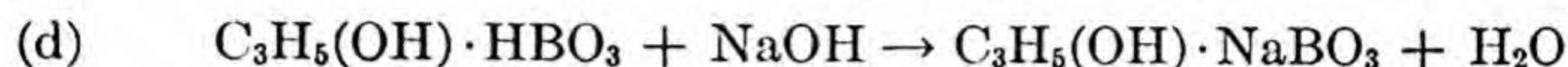
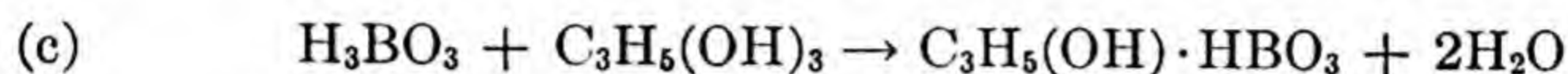
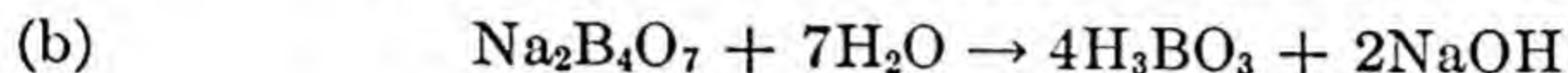
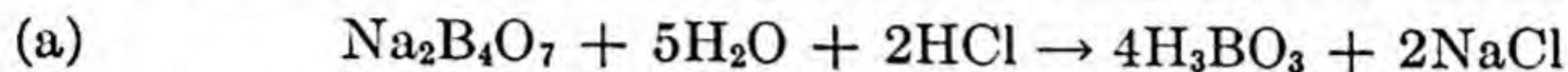


HCl

I-2903

NaOH

Standardizing of acids and bases with borax. Acid may be standardized with borax in direct titration with phenolphthalein as an indicator. A base is titrated with borax solution to which glycerol has been added.



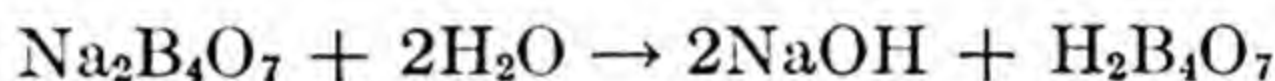
M. G. Mellon and V. Morris, *Ind. and Eng. Chem.*, **17**, 145 (1925)

23

H₂O

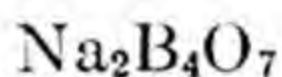
I-2904

When sodium tetraborate dissolves in water it hydrolyzes and gives an alkaline solution.



J. Shields, *K. Sv. Vet. Akad. Handl. Bihang.*, **19**, II, No. 1, 16 (1893)

10

H₂SO₄

I-2905

Borax is converted into sodium sulfate and boric oxide when titrated with a solution of sulfuric acid using litmus as indicator.



Gay-Lussac, *Ann. Chim. Phys.*, **40**, 398 (1829)

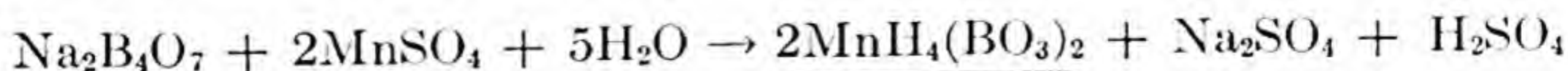
Ref., G. W. Sargent, *J. Am. Chem. Soc.*, **21**, 859 (1899)

1

MnSO₄

I-2906

Solutions of borax and manganous sulfate react at 22° C.



Hartley and Ramage, *J. Chem. Soc.*, (London), **63**, 129 (1893)

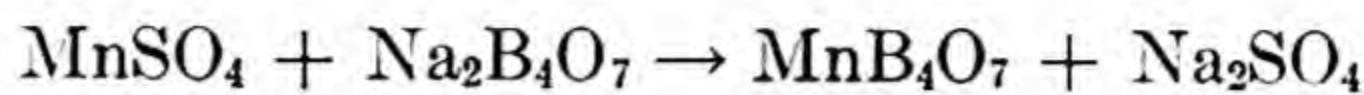
25



MnSO₄

I-2907

A precipitate forms when a solution containing manganese sulfate is reacted with borax.



Smith, Am. Chem. J., **4**, 279 (1882)

Ref., G. W. Sargent, J. Am. Chem. Soc., **21**, 876 (1899)

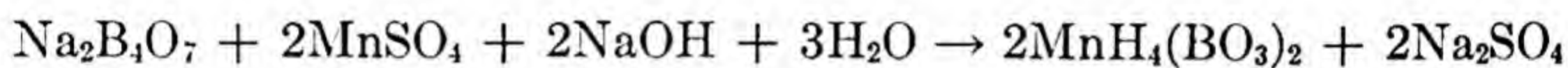
1



MnSO₄ + NaOH

I-2908

Solutions of borax, manganous sulfate and sodium hydroxide react together at 15°.



Hartley and Ramage, J. Chem. Soc., (London), **63**, 129 (1893)

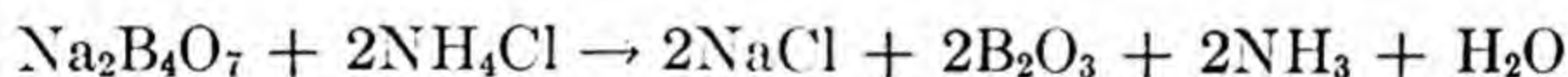
25



NH₄Cl

I-2909

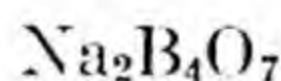
Ammonia is liberated when borax is boiled with ammonium chloride.



Kraut, Z. anal. Chem., **2**, 73, (1863)

Ref., J. Am. Chem. Soc., **21**, 860 (1899)

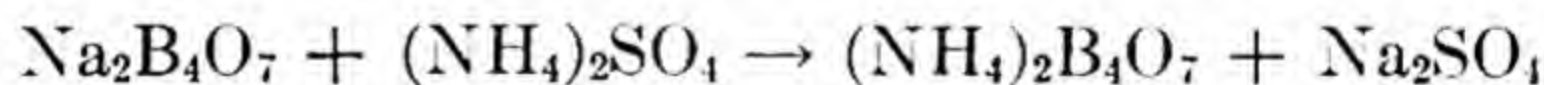
1



(NH₄)₂SO₄

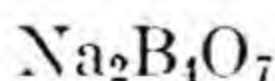
I-2910

Solutions of borax and ammonium sulfate react at room temperature.



M. Keghel, Rev. chim. ind., **23**, 61

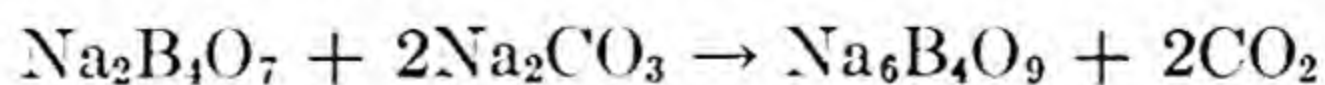
Ref., Chem. Abstr., **6**, 2147 (1912)



Na₂CO₃

I-2911

Borax is melted with sodium carbonate.



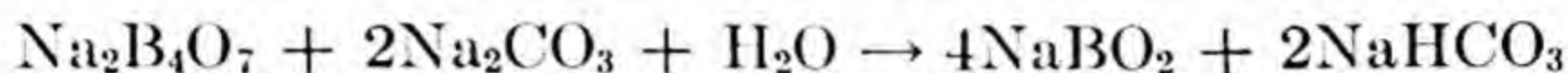
A. Arfvedson, K. Sv. Vet. Acad. Handl., **87**, (1824)

10



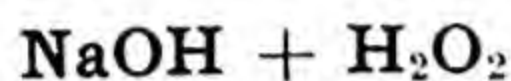
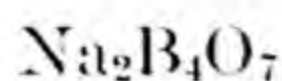
I-2912

Sodium tetraborate and sodium carbonate react to form the metaborate.



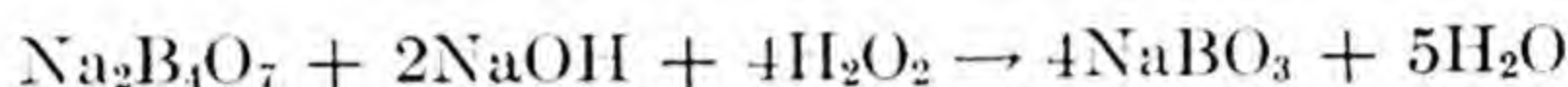
K. Arndt and E. Hantge, *Z. Elektrochem.*, **28**, 265, 268 (1922)

86



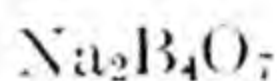
I-2913

A saturated solution of borax containing an equal amount of sodium hydroxide is treated with a double amount of hydrogen peroxide.



Melinkoff and Pessarjewsky, *Ber.*, **36**, 3144 (1897)

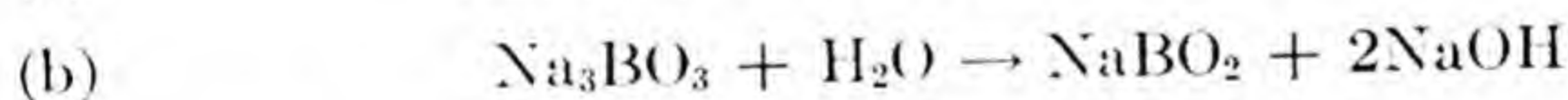
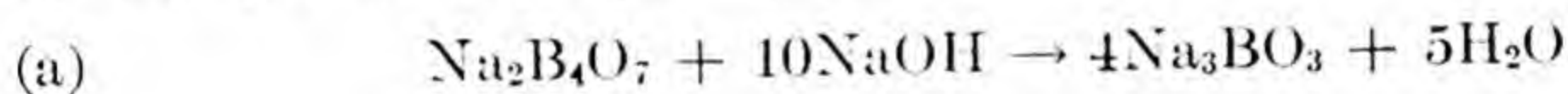
25



€

I-2914

Sodium perborate is formed in solution by electrolyzing a cool alkaline solution of borax (6 g NaOH, 24 g borax per liter) at a high current density (30-60 amps. per sq. dm.)



Pouzens, F. Pat. No. 411,258 (1910)

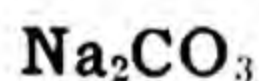
Ref., W. G. Polack, *Trans. Far. Soc.*, **10**, 178 (1914)

85

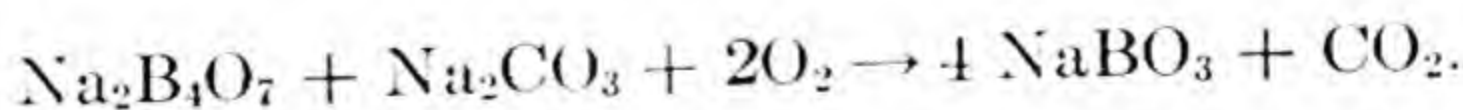


€

I-2915



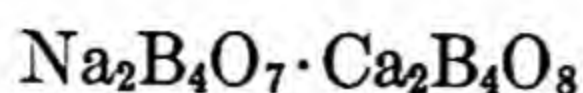
Sodium perborate is made by electrolysis of a soda-borax solution, containing 120 g anhydrous soda and 30 g borax and some chromate per liter. The current density is 10-20 amp/dm², and the bath temperature 14-16°C.



K. Arndt and E. Hantge, *Z. Elektrochem.*, **28**, 267, 273 (1922)

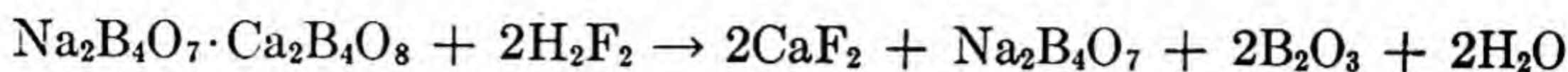
Ref., M. LeBlanc and R. Zellmann, *ibid.*, **29**, 184, 187 (1923)

86

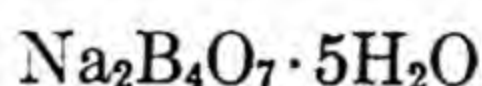


F₂ **I-2916**

Sodium calcium octaborate reacts with fluorine.

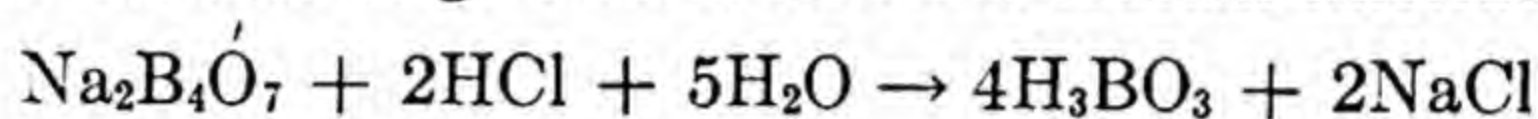


Schuster and Wilhelmy, Chem. Zentr. II, p. 1085 (1897) 25

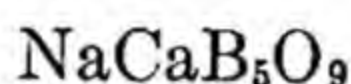


HCl **I-2917**

Borax will hydrolyze in the presence of hydrochloric acid in the standardization of the acid to give boric acid and sodium chloride.



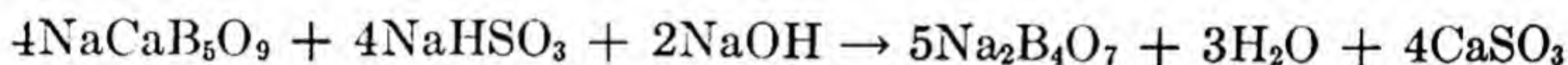
Mellon and Morris, Ind. and Eng. Chem., 17, 145 (1925) 23



NaHSO₃ **I-2918**

NaOH

Boronatrocalcite is stirred into a solution of sodium hydrogen sulfite, made alkaline with sodium hydroxide. The precipitating borax is filtered off.



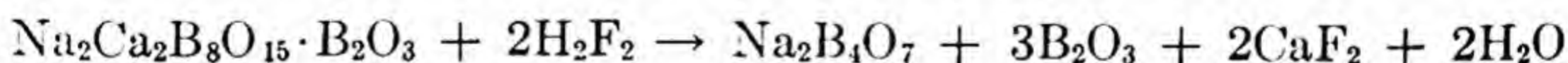
Marquardt and Schulz, Ger. Pat. 81886

Ref., Z. angew. Chem. 8, 385 (1895) 34



H₂F₂ **I-2919**

Boronatrocalcite is decomposed by hydrogen fluoride.

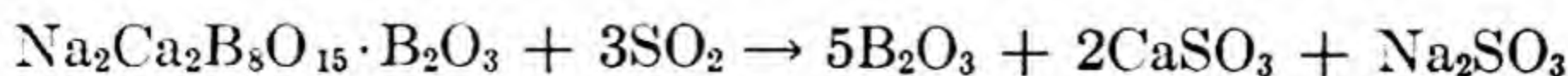


Schuster and Wilhelmi, Ger. Pat. 94050 (1897) 25

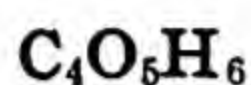


SO₂ **I-2920**

Sulfur dioxide is passed into a solution of boronatrocalcite.

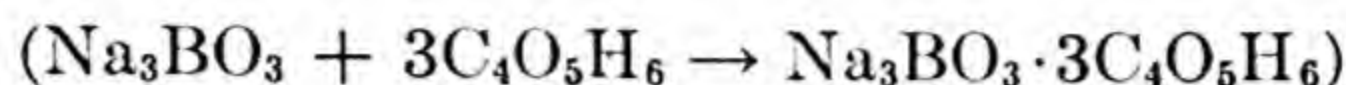


Kelly and Jones, Brit. Pat. 180,110 (1921) 25



I-2921

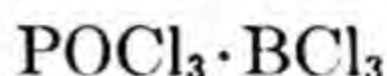
Sodium orthoborate forms a stable complex salt with malic acid.



M. Darmois, *J. Chim. phys.*, **23**, 130 (1926)

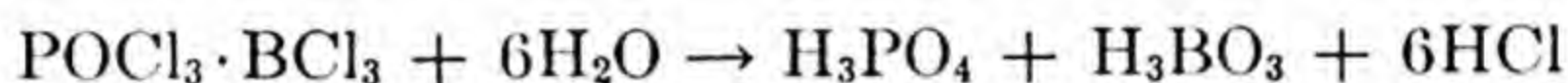
Ref., J. L. Delsal, *J. Chim. phys.*, **35**, 350 (1938)

69



I-2922

Water decomposes the double compound of phosphorus oxychloride and boron trichloride to form phosphoric acid, hydrochloric acid and boric acid.



Gustavson,

Ref., Von Richter, *Ber.*, **4**, 976 (1871)

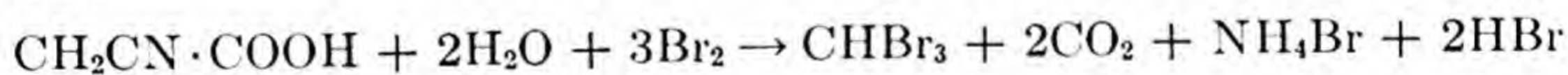
11

BROMINE



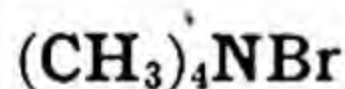
I-2923

Cyanoacetic acid is decomposed by the action of bromine with water to give bromoform, carbon dioxide, ammonium bromide and hydrobromic acid.



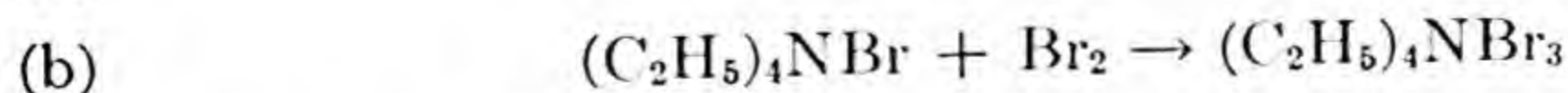
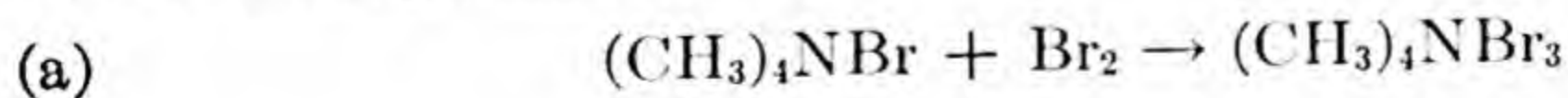
Van't Hoff, *Gazz. Chim. Ital.*, **5**, 44 (1875)

21



I-2924

When tetramethylammonium bromide is dissolved in an aqueous solution of bromine, the tribromide is formed. A similar reaction occurs with tetraethylammonium bromide.



C. K. Tinkler, *J. Chem. Soc.*, (London), **93**, 1614 (1908)

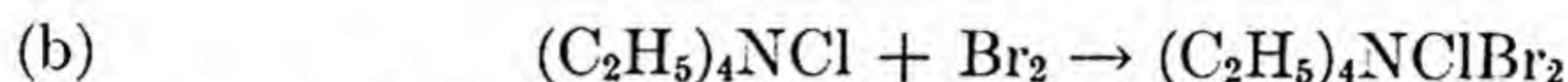
57

Br

(CH₃)₄NCl**I-2925**

When tetramethylammonium chloride is added to bromine water, the chlorodibromide is formed.

A similar reaction occurs with tetraethylammonium chloride.



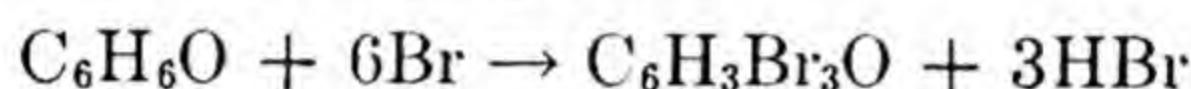
C. K. Tinkler, J. Chem. Soc., (London), **93**, 1615 (1908)

57

Br

C₆H₅OH**I-2926**

If phenol is treated with bromine the reaction products are hydrobromic acid and 2,4,6-tribromophenol.



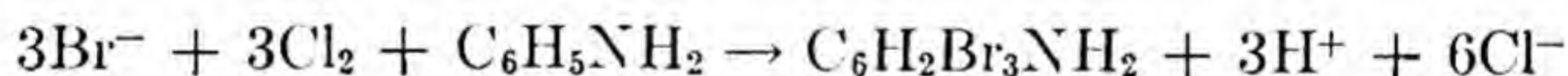
G. Halphen, Ann. Chim. Anal., **8**, 10 (1903)

76

Br

Cl₂ + C₆H₅NH₂**I-2927**

Bromine existing in seawater in the form of its bromide ion is extracted commercially by treating seawater with chlorine and aniline. The bromine is liberated by the chlorine and then reacts with the aniline to form tribromoaniline.



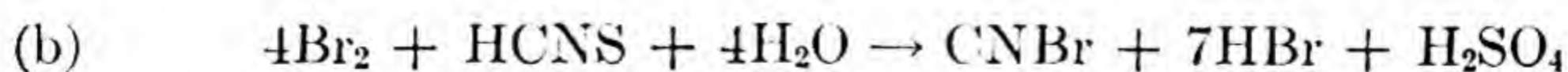
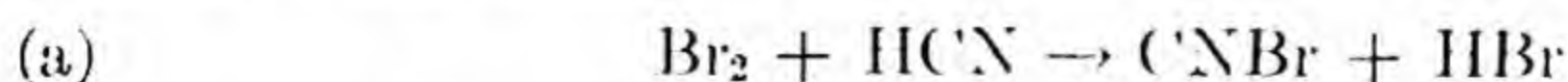
C. Stine, Ind. Eng. Chem., **21**, 434 (1929)

24

Br

HCN**I-2928****HCNS**

Cyanogen bromide is obtained when hydrocyanic acid reacts with bromine. The same type reaction occurs with thiocyanic acid.



E. Schulek, Z. anal. Chem., **62**, 338 (1923)

28

Br

HCl **I-2929**

When bromine is dissolved in hydrochloric acid, HClBr_2 is formed:
A similar reaction occurs with hydrobromic acid.



C. K. Tinkler, J. Chem. Soc., (London), **93**, 1614 (1908) 57

Br

NH_4Br **I-2930**

When ammonium bromide is dissolved in an aqueous solution of bromine, the tribromide is formed.



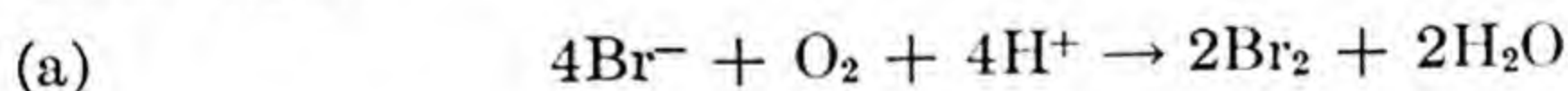
C. K. Tinkler, J. Chem. Soc., (London), **93**, 1614 (1908) 57

Br

O_2 **I-2931**

Light

In presence of oxygen the bromides in solution are decomposed by diffuse light.



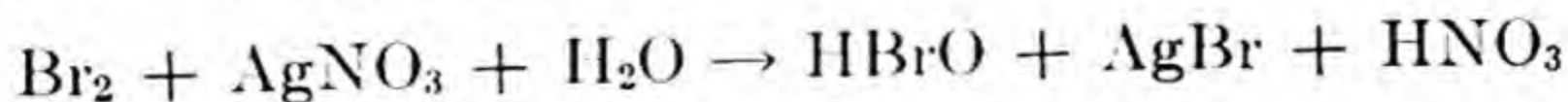
Lewis and Storch, J. Am. Chem. Soc., **39**, 2544 (1917)

Ref., L. de Brouckère, J. Chim. phys., **27**, 543 (1930) 69

Br₂

AgNO_3 **I-2932**

Hypobromous acid may be obtained from the action of silver nitrate and water on pure bromine or a solution of bromine in water.



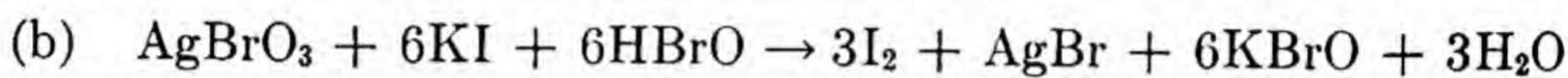
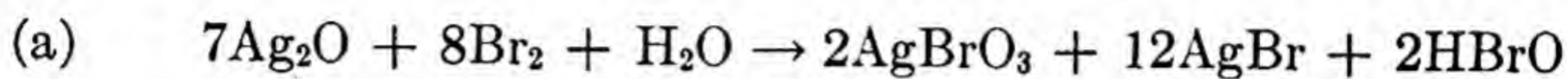
E. Dancer, Chem. News, **6**, 249 (1862) 101

Ag₂O

I-2933

KI

Silver oxide is added to water, and bromine is aspirated through the mixture. Silver bromate and bromide are formed. This product, added to potassium iodide solution without acidifying, liberates iodine.



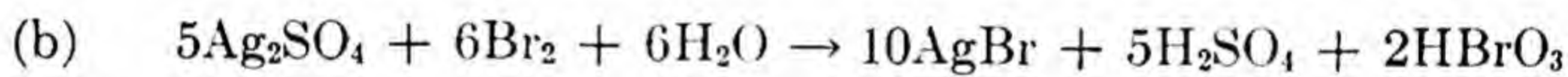
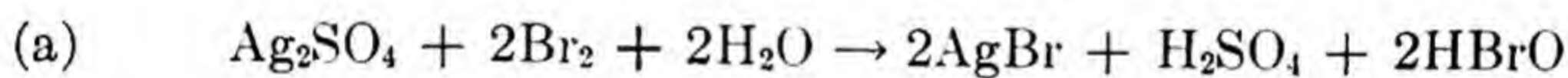
C. W. B. Normand, J. Chem. Soc., (London), **101**, 1852 (1912)

57

Ag₂SO₄

I-2934

When water is added to silver sulfate and bromine is aspirated through the mixture, silver bromide is precipitated. At 0° hypobromous acid is formed. When heated, bromic acid is formed.



C. W. B. Normand, J. Chem. Soc., (London), **101**, 1853 (1912)

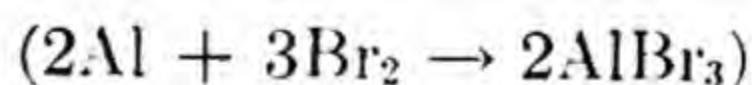
57



Al

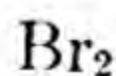
I-2935

Aluminum bromide is prepared by slowly adding bromine to an excess of aluminum.



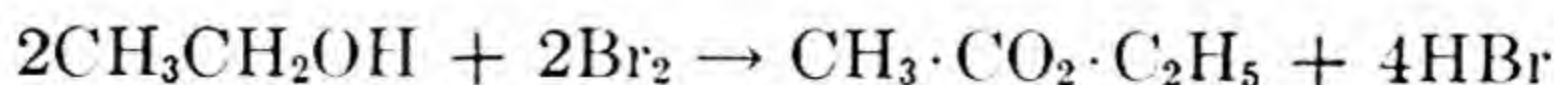
E. L. Gamble, P. Gilmont and J. I. Stiff, J. Am. Chem. Soc., **62**, 1257 (1940)

3

CH₃CH₂OH

I-2936

When bromine and ethyl alcohol react together, ethyl acetate and hydrobromic acid are formed.

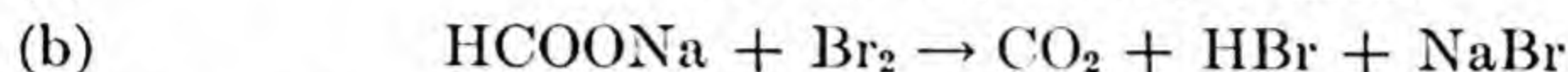


F. G. Donnan and R. LeRossignol, J. Chem. Soc., (London), **83**, 711 (1903)

102

**HCOOH****I-2937**

Formic acid is not oxidized by iodine. Bromine, on the other hand, oxidizes not only the acid but also the formates to form carbon dioxide as is indicated by the following equations.

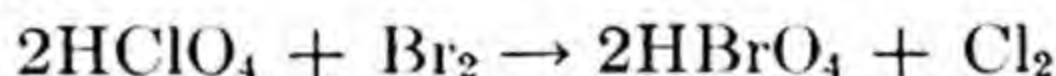


Ladislaus Spitzer, *Ind. Eng. Chem., Anal. Ed.*, **8**, 465 (1936)

44

**HClO₄****I-2938**

Perbromic acid and chlorine are formed when bromine is treated with dilute perchloric acid.



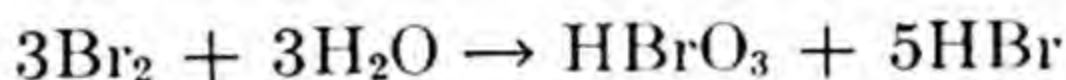
Kammerer, *J. Prakt. Chem.*, **90**, 190 (1863)

Ref., Allison, Bishop and Sommer, *J. Am. Chem. Soc.*, **54**, 618 (1932)

1

**H₂O****I-2939**

In exceptionally dilute solutions free bromine hydrolyzes to form bromic and hydrobromic acids.



Stewart, *Ind. Eng. Chem.*, **26**, 362 (1933)

24

**KBr****I-2940****HBr**

If a soluble bromide is added to bromine solution, the color is diminished with formation of tribromide. Hydrobromic acid reacts similarly.

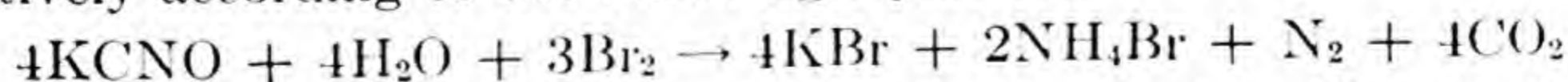


A. F. Joseph and J. N. Jinendradsa, *J. Chem. Soc., (London)*, **99**, 274 (1911)

57

**KCNO****I-2941**

Excess bromine added to a solution of potassium cyanate reacts quantitatively according to the following equation.

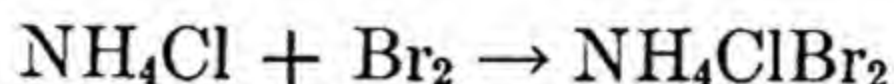


C. W. B. Normand and A. C. Cumming, *J. Chem. Soc., (London)*, **101**, 1864 (1912)

57

**NH₄Cl****I-2942**

On addition of ammonium chloride to bromine water, the chlorodibromide is formed.

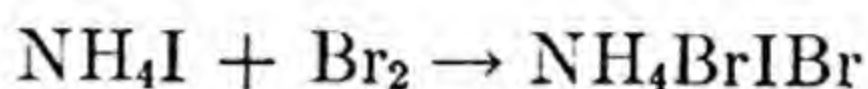


C. K. Tinkler, *J. Chem. Soc. (London)*, **93**, 1615 (1908)

57

**NH₄I****I-2943**

Ammonium bromidobromide is prepared by treating ammonium iodide with bromine vapors.



Jackson and Derby, *Am. Chem. J.*, **24**, 15 (1900)

Ref., C. B. Williams, *J. Am. Chem. Soc.*, **23**, 8 (1901)

1

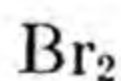
**NO****I-2944**

If (at ordinary temperature) bromine is impregnated with nitric oxide a compound is formed of the formula NOBr₃.

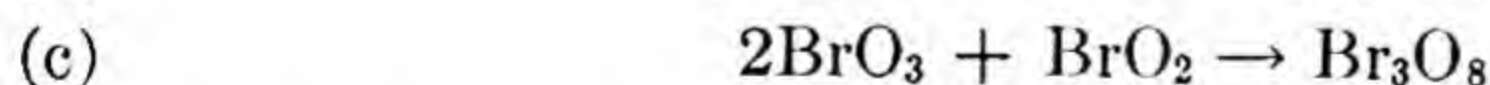


M. M. P. Muir, Ref., R. Gerstl, *Ber.*, **8** (1), 831 (1875)

26

**O₃****I-2945**

Bromine acts as a sensitizer for the photodecomposition of ozone. Under certain conditions an oxide of bromine (c) can be isolated.



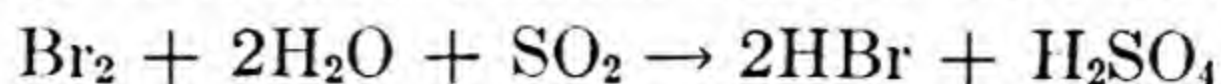
K. F. Bonhoeffer, *Z. Physik*, **13**, 94 (1923)

Ref., R. Mungen and J. W. T. Spinks, *Can. J. Res.*, **B18**, 363 (1940)

69

**SO₂****I-2946**

Pure hydrobromic acid can be obtained by distilling the products formed from the reaction of bromine, sulfur dioxide and water.

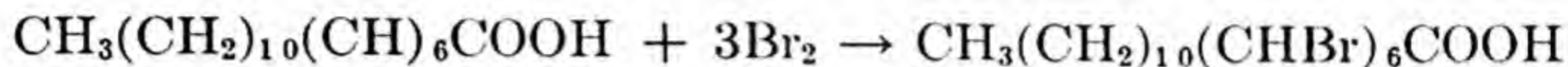


A. Scott, *J. Chem. Soc. (London)* **77**, 650 (1900)

102

**Linolenic Acid****I-2947**

"A method for detection of horse fat in pork, beef, or mutton fat depends on the linoleic acid content. The hexabromides of the fats are: horse, 41.2; pork, 2.8; beef, 3.0; and mutton 3.3 mg. per g. of fat. The addition of 30 or more per cent horse fat was detectable."



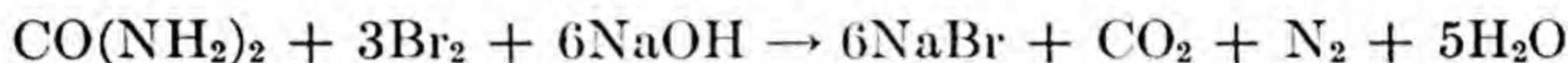
B. Pasche, *Z. Untersuch. Lebensm.*, **76**, 476 (1938)

Ref., *Oil and Soap*, **16**, 5, 96 (1939)

111

**Urea****I-2948**

In alkaline solution bromine is reduced to bromide by urea.

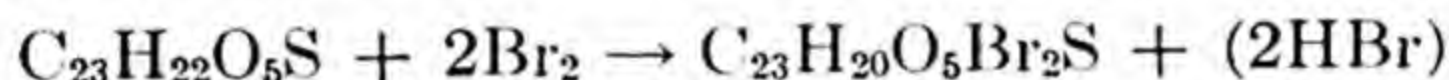


Ref., Booth and Jones, *Ind. Eng. Chem. Anal. Ed.*, **2**, 239 (1930)

33

**Xylenol blue****I-2949**

Dibromoxylenol sulfonaphthalein is formed as pale pink crystals when 3.1 parts bromine are added to 1 part xylenol blue suspended in 10 parts glacial acetic acid.

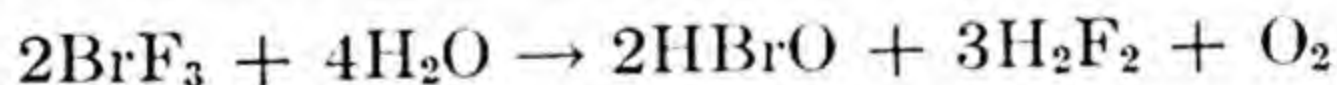


A. Cohen, *Biochem. J.*, **17**, 535 (1923)

53

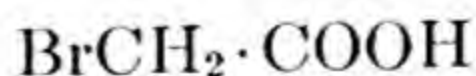
**H₂O****I-2950**

Bromine trifluoride is decomposed by water and forms hydrofluoric acid, hypobromous acid and oxygen.

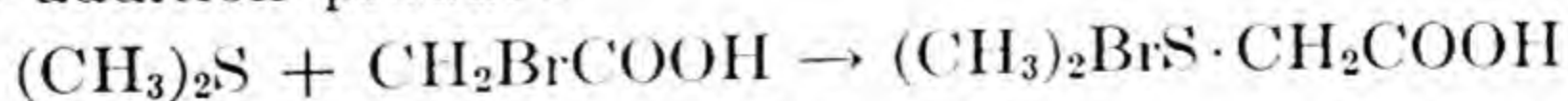


P. Lebeau, *Ann. Chim. Phys. [VIII]*, **9**, 261 (1906)

100

**(CH₃)₂S****I-2951**

Dimethyl sulfide combines with monobromo acetic acid to form a betaine-like addition product.

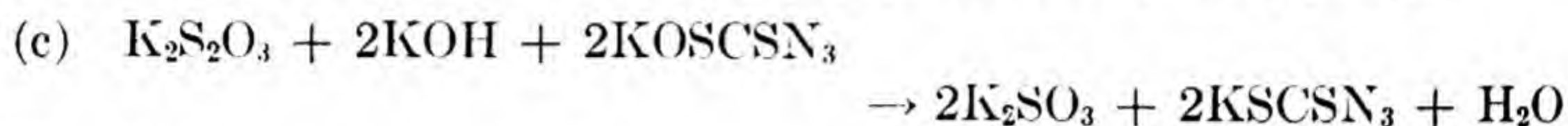
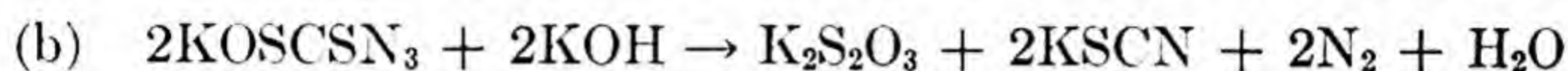
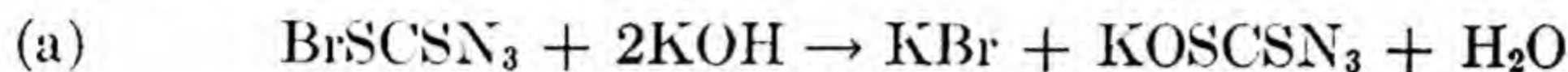


Crum Brown and E. A. Letts, *Ber.*, **7**, 696 (1874)

11

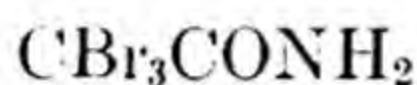
**KOH****I-2952**

On hydrolysis of bromine azidodithio-carbonate in concentrated solutions of potassium hydroxide, the reactions are believed to take place as shown below, since sulfites and thiosulfates are demonstrated to be present.

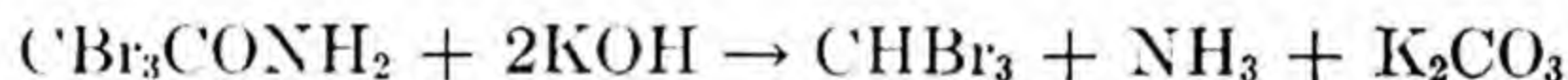


Wm. H. Gardner and A. W. Browne, *J. Am. Chem. Soc.*, **49**, 2762 (1927)

13

**KOH****I-2953**

Tribromoacetamide with potassium hydroxide gives bromoform, ammonia and potassium carbonate.

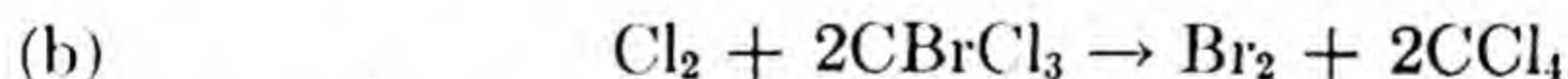
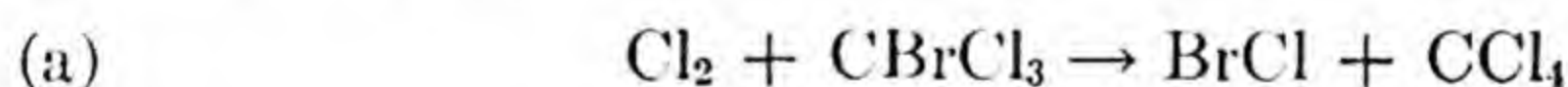


Gnareschi, *Gazz. Chim. Ital.*, **6**, 370 (1876)

21

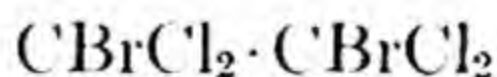
**Cl₂****I-2954**

Carbon tetrachloride is formed when an excess of chlorine reacts with bromotrichloromethane.



Vesper and Rollefson, *J. Am. Chem. Soc.*, **56**, 1456 (1934)

1

**Δ****I-2955**

At 185°C. symmetrical dibromotetrachloroethane decomposes into bromine and tetrachloroethylene.



E. Bourgoïn,

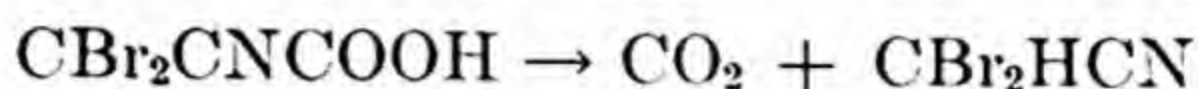
Ref., A. Henninger, *Ber.*, **7**, 1795 (1874)

11

$\text{CBr}_2\text{CNCOOH}$ Δ

I-2956

When dibromocyanoacetic acid is heated to 60°C ., it decomposes into carbon dioxide and dibromoacetonitrile.



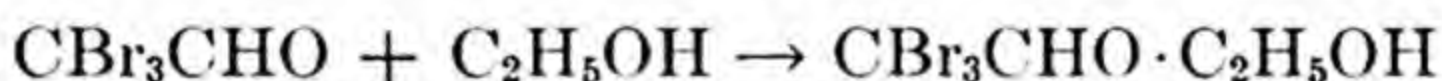
J. Van't Hoff, Ber., 7, 1572 (1874)

11

 CBr_3CHO $\text{C}_2\text{H}_5\text{OH}$

I-2957

Absolute alcohol when mixed with bromal forms bromal alcoholate.



L. Schaffer, Ber., 4, 367 (1871)

11

 CBr_3CHO HNO_3

I-2958

Fuming nitric acid quickly oxidizes bromal to tribromoacetic acid.



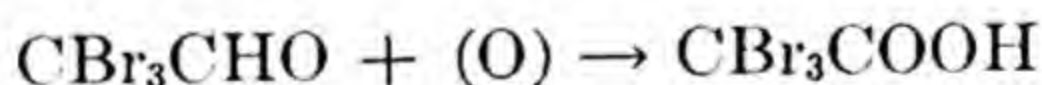
L. Schaffer, Ber., 4, 370 (1871)

11

 CBr_3CHO HNO_3

I-2959

Nitric acid oxidizes bromal to tribromoacetic acid.



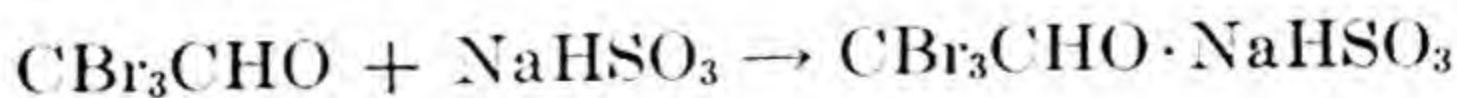
H. Gal,
Ref., A. Henninger, Ber., 6, 1268 (1873)

11

 CBr_3CHO NaHSO_3

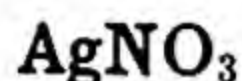
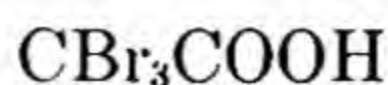
I-2960

Bromal forms an addition product when shaken with a concentrated solution of sodium bisulfite. The addition product may be purified by recrystallization from water.



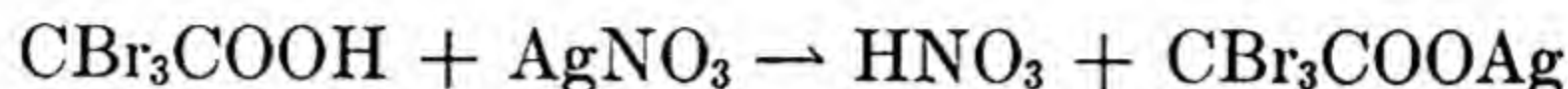
L. Schaffer, Ber., 4, 367 (1871)

11



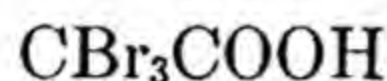
I-2961

Dilute tribromoacetic acid when treated with silver nitrate forms the very unstable silver salt.



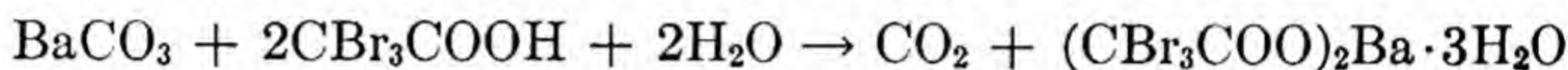
L. Schaffer, Ber., 4, 371 (1871)

11



I-2962

Barium carbonate reacts with a solution of tribromoacetic acid to form barium tribromoacetate and carbon dioxide.



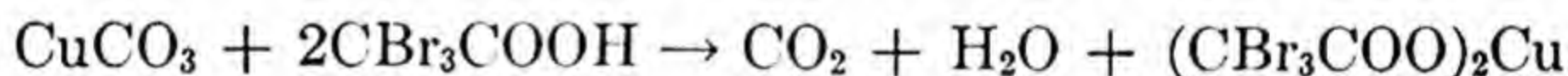
L. Schaffer, Ber., 4, 371 (1871)

11



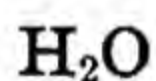
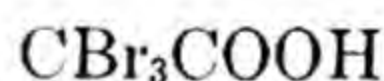
I-2963

Copper carbonate reacts with solutions of tribromoacetic acid to form copper tribromoacetate and carbon dioxide.



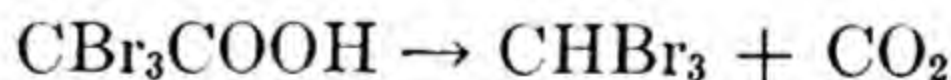
L. Schaffer, Ber., 4, 371 (1871)

11



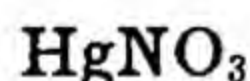
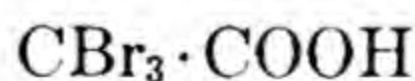
I-2964

Tribromoacetic acid solutions (aqueous or alcoholic) are unstable toward heat and decompose into bromoform and carbon dioxide.



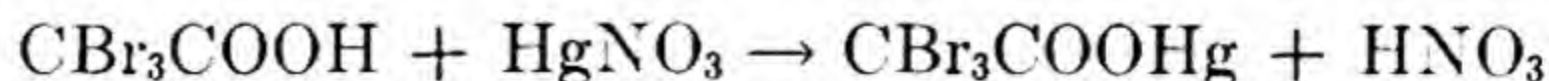
L. Schaffer, Ber., 4, 371 (1871)

11



I-2965

Dilute tribromoacetic acid when treated with mercurous nitrate forms the moisture- and light-unstable salt of mercurous tribromoacetate.

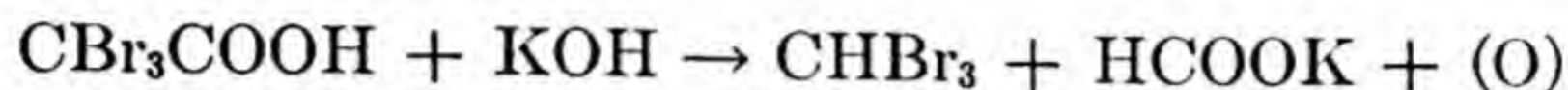


L. Schaffer, Ber., 4, 371 (1871)

11

**KOH****I-2966**

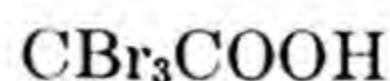
Potassium hydroxide decomposes tribromoacetic acid to form bromoform and potassium formate.



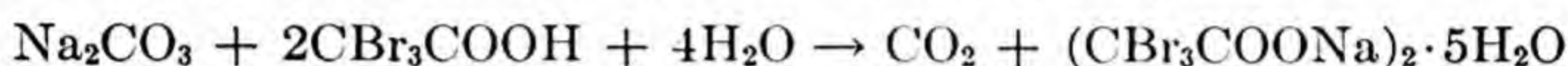
H. Gal.,

Ref., A. Henninger, Ber., **6**, 1268 (1873)

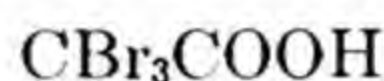
11

**Na₂CO₃****I-2967**

Sodium carbonate reacts with tribromoacetic acid to form the very unstable salt, sodium tribromoacetate and carbon dioxide.

L. Schaffer, Ber., **4**, 371 (1871)

11

**PbCO₃****I-2968**

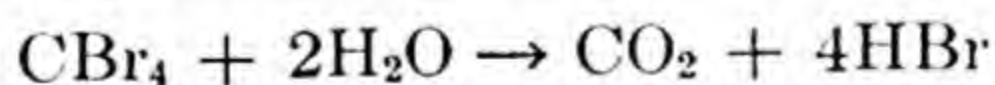
Lead carbonate reacts with tribromoacetic acid to form lead tribromoacetate and carbon dioxide.

L. Schaffer, Ber., **4**, 371 (1871)

11

**H₂O****I-2969**

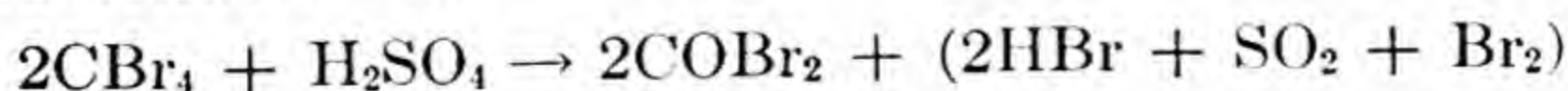
Carbon tetrabromide heated with water to a temp. of 200° produces carbon dioxide and hydrobromic acid.

G. Ponzio, Gazz. chim. ital., **36**², 148 (1906)

21

**H₂SO₄****I-2970**

Carbonyl bromide is formed by the action of concentrated sulfuric acid on carbon tetrabromide.

R. W. Dornte, J. Am. Chem. Soc., **55**, 4127 (1933)

1



Δ

I-2971

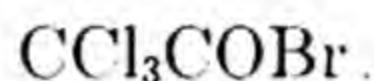
When carbon tetrabromide is led through a red hot tube it is decomposed into bromine and carbon. (A little hexabromoethane is also formed.)



Bolas and Groves,

Ref., R. Gerstl, Ber., **3**, 509 (1870)

11

 $\text{C}_2\text{H}_5\text{OH}$

I-2972

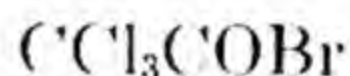
Ethanol reacts with the acid bromide of trichloroacetic acid to form ethyl trichloroacetate and hydrogen bromide.



H. Gal,

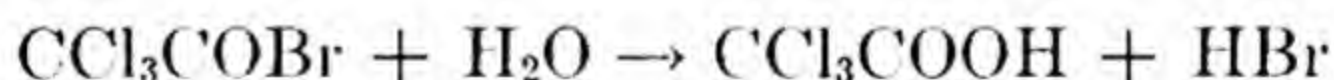
Ref., A. Henninger, Ber., **6**, 571 (1873)

11

 H_2O

I-2973

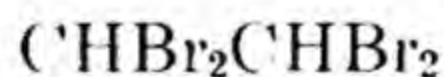
Water reacts with the acid bromide of trichloroacetic acid to form trichloroacetic and hydrobromic acids.



H. Gal,

Ref., A. Henninger, Ber., **6**, 571 (1873)

11

 Cl_2

I-2974

Chlorine reacts quickly in sunlight, more slowly in diffused day light, with acetylene tetrabromide to form symmetrical dibromotetrachloroethane



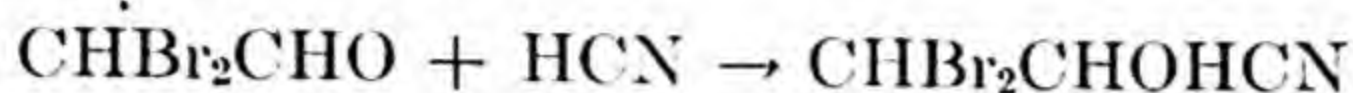
E. Bourgoin,

Ref., A. Henninger, Ber., **7**, 1795 (1874)

11

**HCN****I-2975**

Hydrocyanic acid combines with dibromoacetaldehyde to form the nitrile of dibromolactic acid.

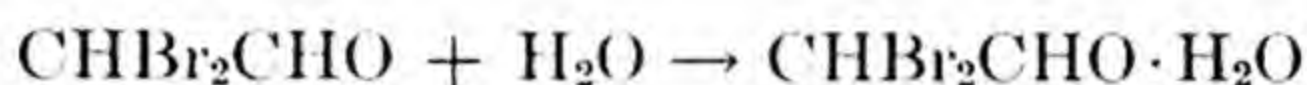


A. Pinner, Ber., 7, 1801 (1874)

11

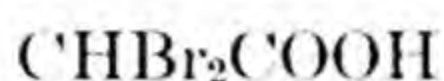
**H₂O****I-2976**

Dibromoacetaldehyde when added to water (mole for mole) forms a crystalline hydrate.

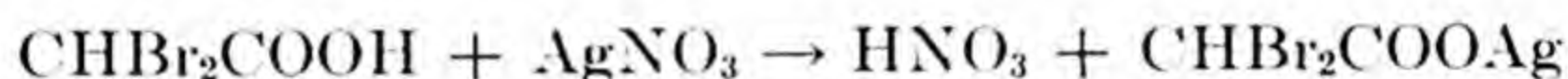


A. Pinner, Ber., 7, 1500 (1874)

11

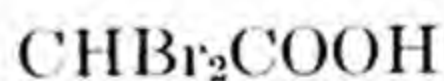
**AgNO₃****I-2977**

Silver nitrate when treated with a dilute solution of dibromoacetic acid, forms the insoluble and unstable silver dibromoacetate.

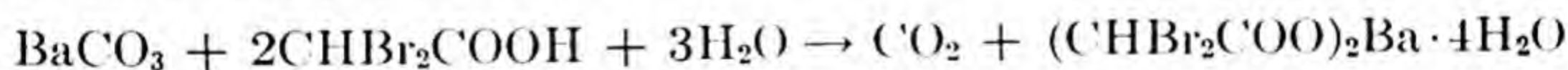


L. Schaffer, Ber., 4, 369 (1871)

11

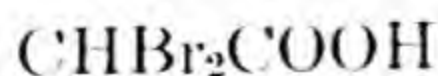
**BaCO₃****I-2978**

Barium carbonate reacts with dibromoacetic acid to form barium dibromoacetate and carbon dioxide.

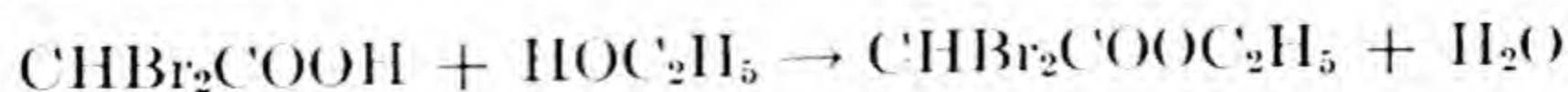


L. Schaffer, Ber., 4, 368 (1871)

11

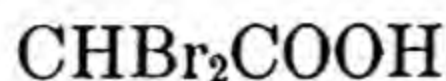
**C₂H₅OH****I-2979**

When dibromoacetic acid and ethyl alcohol are heated on the water bath under reflux, the ester is formed.

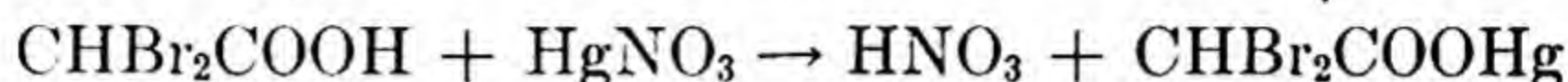


L. Carius, Ber., 3, 337 (1870)

11

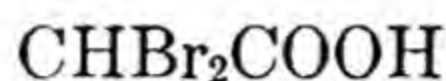
**HgNO₃****I-2980**

Mercurous nitrate reacts with dibromoacetic acid (dilute solution) to form mercurous dibromoacetate and nitric acid.

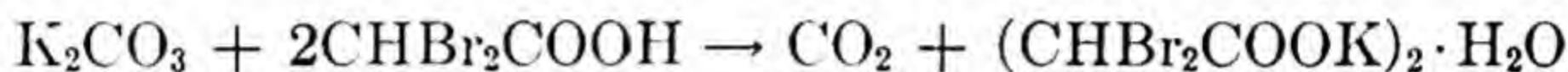


L. Schaffer, Ber., 4, 369 (1871)

11

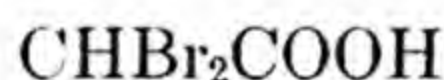
**K₂CO₃****I-2981**

Potassium carbonate when neutralized by dibromoacetic acid, forms potassium dibromoacetate and carbon dioxide.

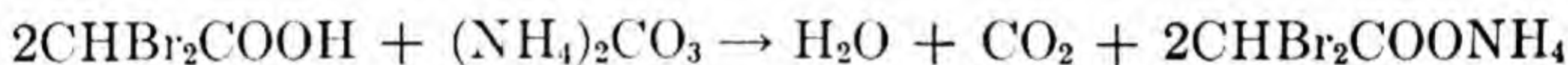


L. Schaffer, Ber., 4, 368 (1871)

11

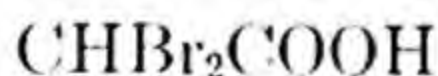
**(NH₄)₂CO₃****I-2982**

Ammonium carbonate when neutralized with dibromoacetic acid, forms ammonium dibromoacetate, carbon dioxide, and water

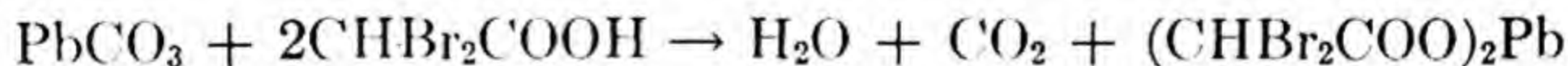


L. Schaffer, Ber., 4, 368 (1871)

11

**PbCO₃****I-2983**

Lead carbonate reacts with dibromoacetic acid to form lead dibromoacetate, water and carbon dioxide.

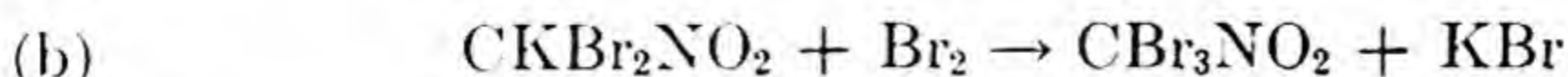
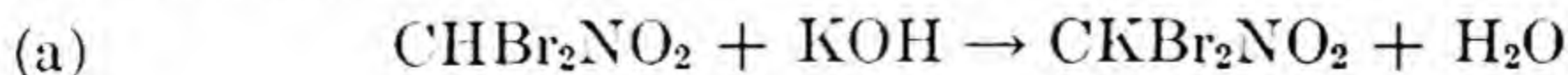


L. Schaffer, Ber., 4, 368 (1871)

11

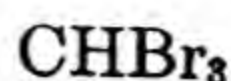
**KOH****I-2984****Br₂**

Dibromo nitroethane in the presence of bromine and potassium hydroxide forms bromopicrin. It is a neutral compound of stifling odor.



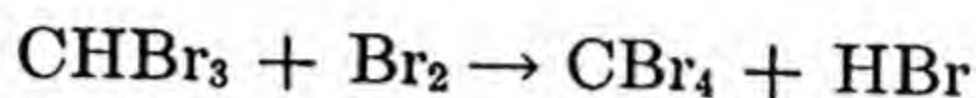
J. Tscherniak, Ber., 7, 921 (1874)

11

Br₂

I-2985

When bromoform is heated with bromine and iodine (3:1) in a sealed tube at 150°C for 24 hours, carbon tetrabromide and hydrobromic acid are formed (N.B. the tube must be opened several times during the heating)



Bolas and Groves,
Ref., R. Gerstl, Ber., 3, 509 (1870)

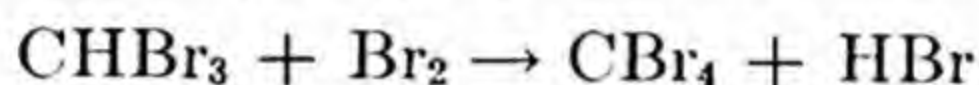
11

Br₂

I-2986

light

Bromine reacts with bromoform in daylight to form tetrabromo methane. The presence of a dilute base greatly hastens this reaction. The rate of reaction is roughly proportional to the light intensity.



Habermann,
Ref., E. Ludwig, Ber., 6, 549 (1873)

11



Ephedrine

I-2987

Ephedrine alkaloid was dissolved in bromoform and let stand at room temperature. In 3 days, crystals of ephedrine hydrobromide deposited.



Steldt and Chen, J. Am. Pharm. Assoc., 29, 106 (1940)

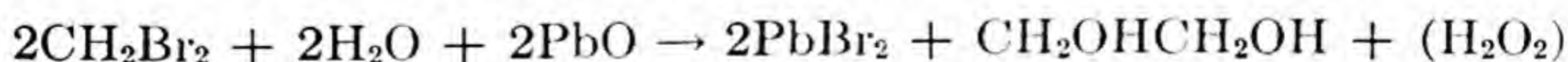
112



PbO

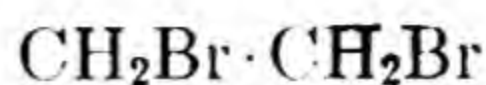
I-2988

Methylene bromide when heated to 140–150°C. in a sealed tube with 20 times the amount of water and excess of lead oxide (or carbonate) forms lead bromide, ethylene glycol, and a trace of ethylene oxide.

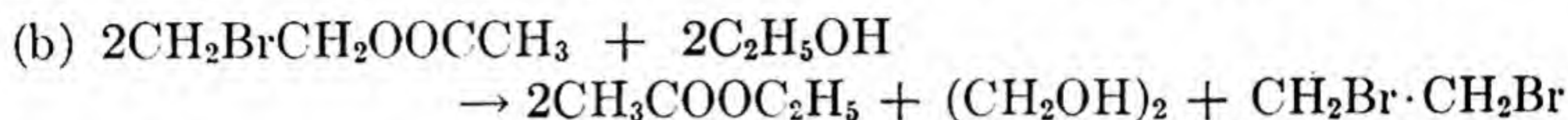
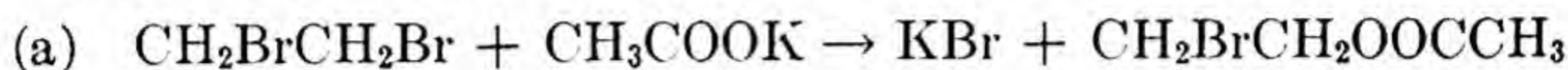


A. Jeltekow,
Ref., F. Wreden, Ber., 6, 558 (1873)

11

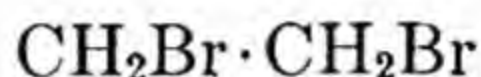
**CH₃COOK****I-2989****C₂H₅OH**

When one mole of ethylene dibromide and one mole of anhydrous potassium acetate and four moles of 80% ethanol are refluxed 16–18 hours, ethylene glycol is formed. Yield 10%.

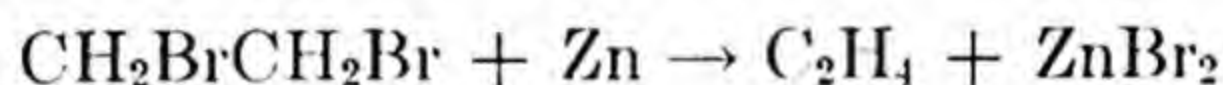


Eugen Demole, *Ber.*, 7, 642 (1874)

11

**Zn****I-2990**

Ethylene dibromide when heated with a zinc-copper couple in the presence of a little water forms ethylene and zinc bromide.



Gladstone and Tribe,
Ref., R. Gerstl, *Ber.*, 7, 364 (1874)

11

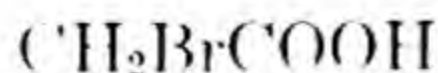
**CH₂BrCHO****I-2991**

If the temperature of a mixture of HBr and CH₂BrCHO is allowed to rise above 0°C. a reaction proceeds spontaneously with the formation of two layers of brown solution. The lower layer is alpha dibromocrotonic aldehyde and the upper layer is a water solution of HBr. This reaction is never complete.

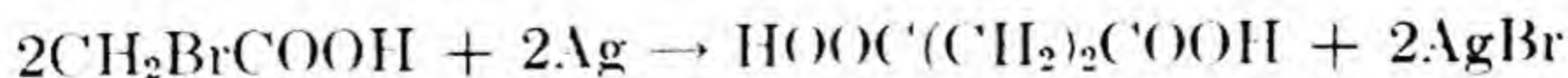


P. Freudler, *Bull. Soc. Chim.*, 1, 67 (1907)

31

**Ag****I-2992**

When bromoacetic acid is heated with silver dust in a sealed tube to 130°C., some succinic acid is formed. (By-products contain bromine and gave an evil odor.)



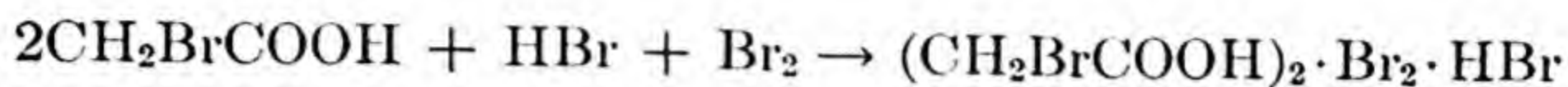
A. Steiner, *Ber.*, 7, 185 (1873)

11

CH₂BrCOOHHBr + Br₂

I-2993

Monobromoacetic acid which has been saturated with dry hydrogen bromide forms an addition product when bromine is added with good cooling.



A. Steiner, Ber., 7, 184 (1874)

11

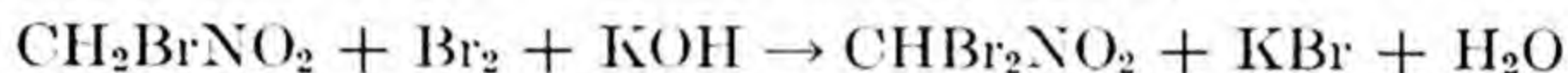
CH₂BrNO₂

KOH

I-2994

Br₂

Calculated quantities of bromonitromethane, bromine, and potassium hydroxide when mixed and cooled internally with ice, form dibromonitromethane. It is necessary to work fast, as bromine decomposes dibromonitromethane. Mercury is used to remove excess bromine. B.P. 155–160°C. (with decomposition)



J. Tscherniak, Ber., 7, 920 (1874)

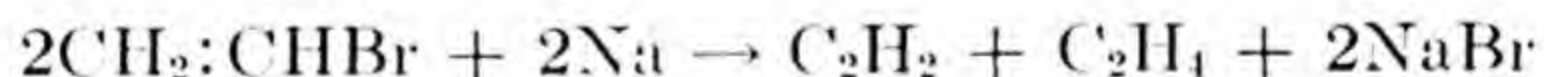
11

CH₂:CHBr

Na

I-2995

Vinyl bromide when heated with sodium in a sealed tube at 110° C. for 48 hours, forms acetylene, ethylene and sodium bromide.



E. Fuchs, Ber., 5, 768 (1872)

11

CH₂:CHBr

HI

I-2996

Vinyl bromide reacts with dry hydrogen iodide when the two components are subjected to pressure and allowed to stand for a week at room temperature, forming one iodo and one bromoethane (see reference for details). B.P. 142–143°C.

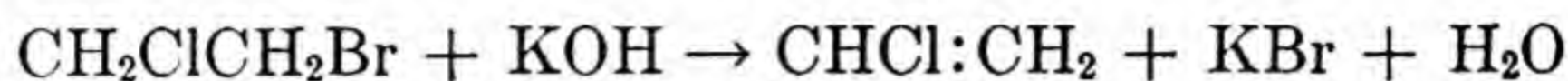


H. Lagermark, Ber., 7, 912 (1874)

11

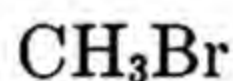
**KOH****I-2997**

When 1-chloro 2-bromoethane is warmed with an alcoholic potash, vinyl chloride is evolved.

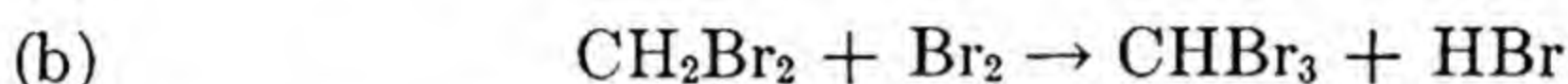
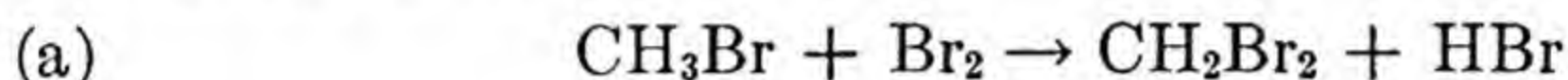


L. Henry, Ber., **3**, 599 (1870)

11

**Br₂****I-2998**

Methyl bromide when heated with one mole of bromine in a sealed tube at 250°C for 3–4 hours, forms dibromo and tribromo methane.

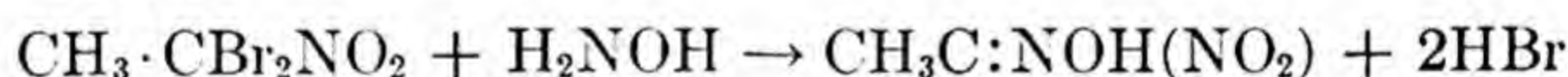


A. Steiner, Ber., **7**, 507 (1874)

11

**H₂NOH****I-2999**

When dibromonitroethane is added to a hydroxyl amine solution (excess) and allowed to stand for 12 hours, ethylnitrolic acid is formed. (Yield 32%.)

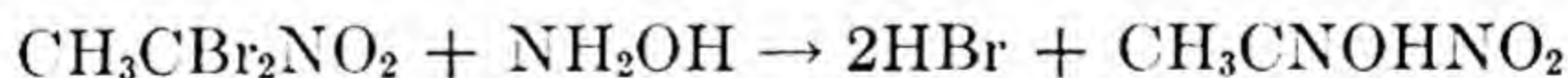


Victor Meyer and J. Locher, Ber., **7**, 1139 (1874)

11

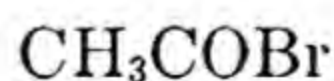
**NH₂OH****I-3000**

Ethylnitrolic acid may be formed by the reaction between dibromonitroethane and hydroxylamine.

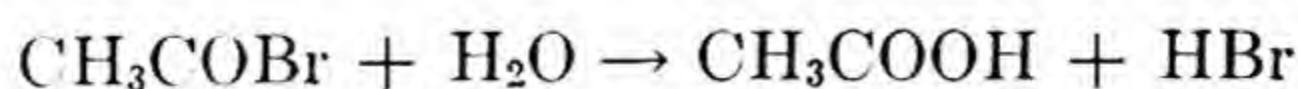


T. E. Thorpe, J. Chem. Soc. (London), **77**, 178 (1900)

102

**H₂O****I-3001**

Acetyl bromide by its reaction with water is transformed into acetic acid.

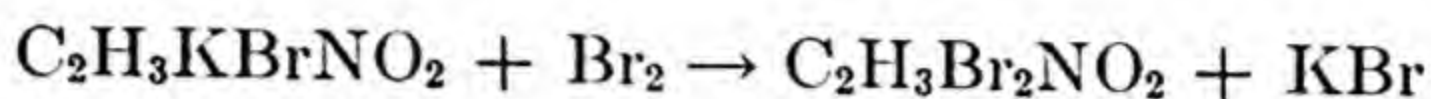


A. Kekule, Chem. News, **9**, 210 (1864)

101

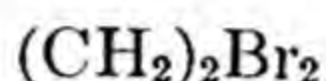
**Br₂****I-3002**

When monobromonitroethane is dissolved in potassium hydroxide and slowly added to the calculated amount of bromine, dibromonitroethane is formed.



J. Tscherniak, *Ber.*, **7**, 918 (1874)

11

**CH₃CONHNa****I-3003**

When sodiumacetamide and ethylene bromide are reacted together in the presence of alcohol as a carrier, acetamide, sodium bromide and vinyl bromide are formed.

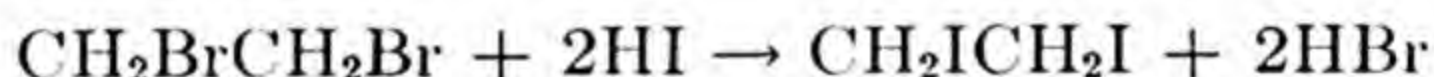


A. W. Titherley, *J. Chem. Soc. (London)*, **79**, 391 (1901)

102

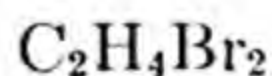
**HI****I-3004**

When ethylene dibromide is heated with concentrated hydriodic acid, diiodoethylene and hydrobromic acid are formed.

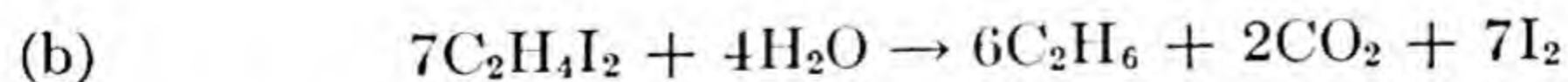
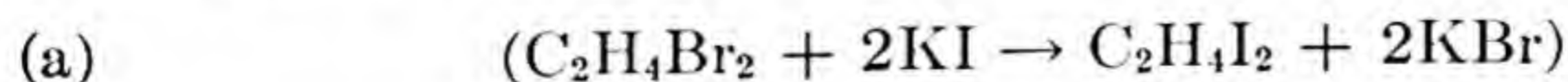


Sorokin,
Ref., V. Von Richter, *Ber.*, **3**, 626 (1870)

11

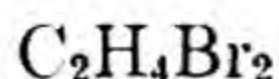
**KI****I-3005**

Ethylene bromide when heated in a sealed tube for ten hours with a solution of potassium iodide, is converted into ethylene iodide which hydrolyzes to form ethane.



Berthelot, *Chem. News*, **1**, 101 (1867)

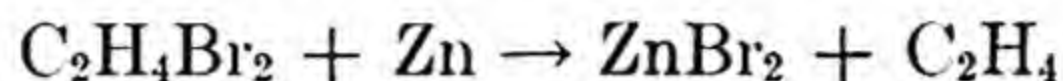
101



Zn

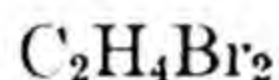
I-3006

When ethylene bromide is treated with metallic zinc (or the zinc-copper couple), ethylene gas and zinc bromide are formed. In the presence of water ethylene bromide is rapidly decomposed at ordinary temperatures. In the presence of alcohol the reaction is very violent.



J. H. Gladstone and Alfred Tribe, *J. Chem. Soc.*, **27**, 406 (1874)

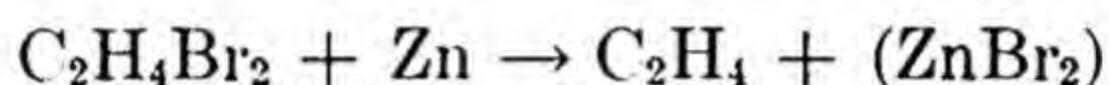
48



Zn

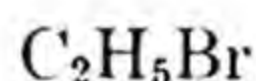
I-3007

Ethylene was prepared by the action of zinc on a mixture of equal volumes of ethylene dibromide and ethyl alcohol.



W. Cawood and H. S. Patterson, *Trans. Roy. Soc. (London)* **236A**, 77-102 (1937)

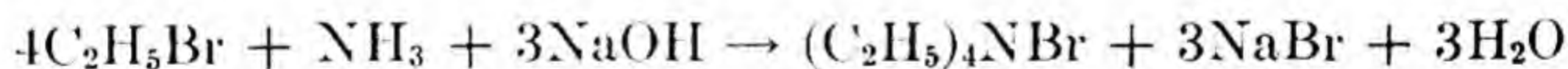
105

NH₃

I-3008

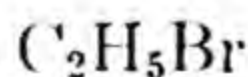
NaOH

Tetraethylammonium bromide may be prepared by mixing ethyl bromide and strong aqueous ammonia in absolute alcohol. Small quantities of a strong sodium hydroxide are added at intervals of about one week until an excess remains.



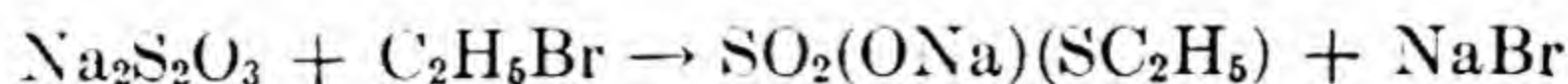
A. Scott, *J. Chem. Soc. (London)*, **95**, Pt. 1, 1201 (1909)

103

Na₂S₂O₃

I-3009

Sodium thiosulfate reacts with ethyl bromide when refluxed for several hours. Sodium ethyl thiosulfate and sodium bromide are formed.

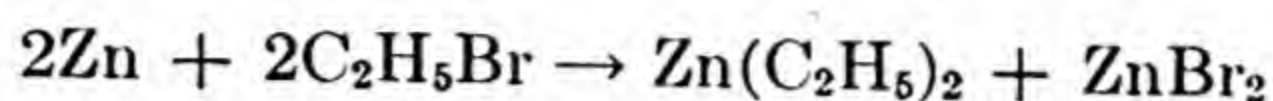


Hans Bunte, *Ber.*, **7**, 647 (1874)

11

**Zn****I-3010**

Coarse zinc powder when gently warmed with ethyl bromide, forms zinc diethyl.

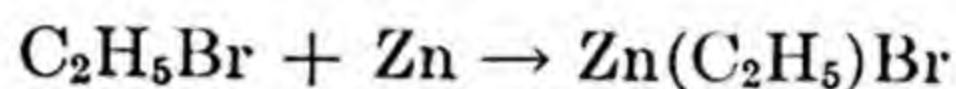


H. Wilchelhaus, Ber., **1**, 140 (1868)

11

**Zn****I-3011**

Zinc-ethylbromide is formed when ethyl alcohol is boiled in the presence of the *dry* zinc-copper couple.

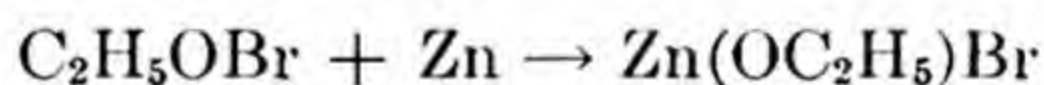


J. H. Gladstone and Alfred Tribe, J. Chem. Soc., **27**, 411 (1874)

48

**Zn****I-3012**

Ethanol bromide, when treated with metallic zinc or the zinc-copper couple, yields zinc bromoethylate.



J. H. Gladstone and Alfred Tribe, J. Chem. Soc., **27**, 414 (1874)

48

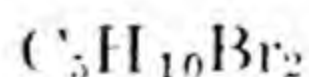
**Zn****I-3013**

The zinc-copper couple acts on propylene bromide by decomposing it into propylene and zinc bromide. The evolution of propylene gas lasts about 24 hours. Water facilitates the reaction, whereas alcohol and ether retard it.

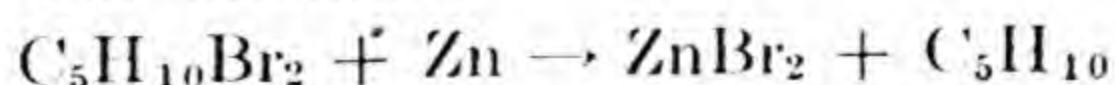


J. H. Gladstone and Alfred Tribe, J. Chem. Soc., **27**, 408 (1874)

48

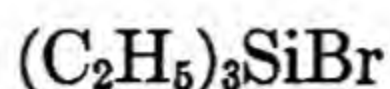
**Zn****I-3014**

Treatment of amylene bromide with the zinc-copper couple produces amylene gas and zinc bromide.



J. H. Gladstone and Alfred Tribe, J. Chem. Soc., **27**, 409 (1874)

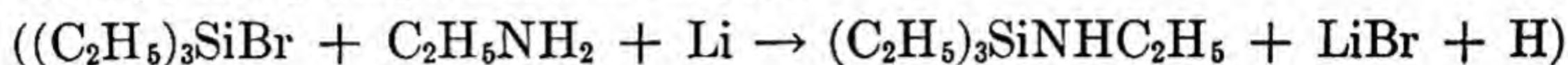
48



I-3015

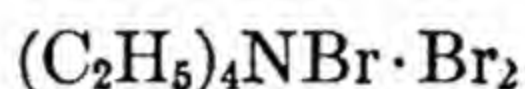


When a solution of triethyl silicon bromide is treated with metallic lithium, one equivalent of H is evolved per mole of the bromide and triethyl silicylethylamine is formed.



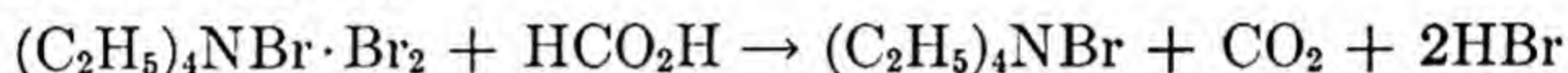
C. A. Kraus and W. K. Nelson, J. Am. Chem. Soc., **56**, 199 (1934)

25



I-3016

If tetraethylammonium perbromide is boiled with dilute formic acid the products are tetraethylammonium bromide, hydrobromic acid and carbon dioxide.



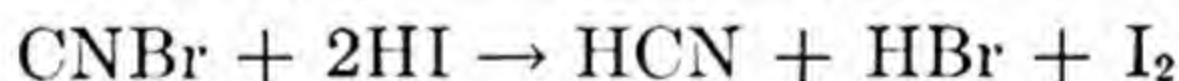
A. Scott, J. Chem. Soc. (London), **95**, 1, 12C1 (1909)

103



I-3017

At ordinary temperatures cyanogen bromide reacts with hydriodic acid to form hydrocyanic acid, hydrobromic acid and iodine.



F. D. Chattaway and J. M. Wadmore, J. Chem. Soc., (London), **81**, 196 (1902)

13

102



I-3018

When cyanogen bromide is treated with hydrogen sulfide, hydrocyanic acid, hydrogen bromide and free sulfur are formed.

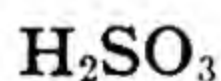


F. D. Chattaway and J. M. Wadmore, J. Chem. Soc., (London) **81**, 192 (1902)

102

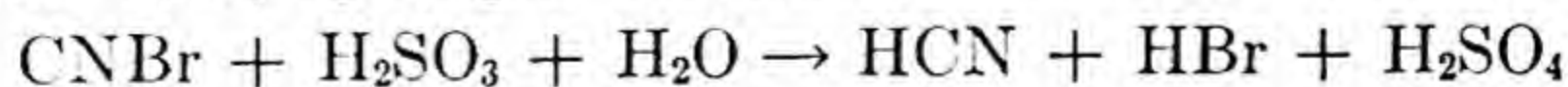
Ref., *ibid.*, J. Chem. Soc., **81**¹, 196 (1902)

13



I-3019

When cyanogen bromide is treated with sulfurous acid and water, hydrocyanic acid, hydrogen bromide and sulfuric acid are formed.



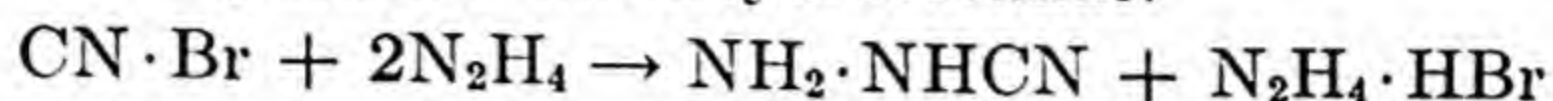
F. D. Chattaway and J. M. Wadmore, J. Chem. Soc. (London) **81**, 192 (1902)

102

CNBr

N₂H₄**I-3020**

Cyanogen bromide acts on hydrazine in a water solution to give amino cyanamide and hydrazine monohydrobromide.



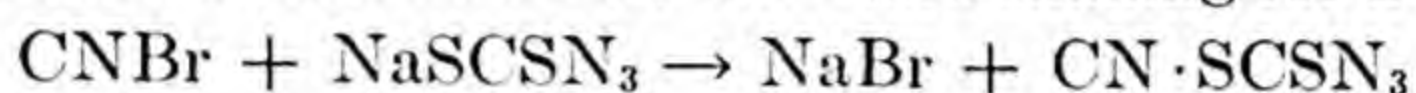
Guido Pellizzari and Carlo Cantoni, *Gazz. Chim. Ital.* **35**¹, 291 (1905)

21

CNBr

NaSCSN₃**I-3021**

A cold aqueous solution of sodium azidodithiocarbondisulfide added to freshly prepared cyanogen bromide, reacts to form cyanogen azido-dithiocarbondisulfide which separates as a fine crystalline solid on cooling the reaction flask in an ice bath and shaking for a few minutes.



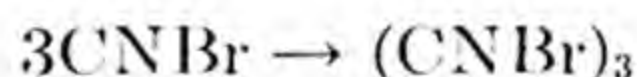
L. F. Audrieth, A. W. Browne and C. W. Mason, *J. Am. Chem. Soc.*, **52**, 2800 (1930)

13

CNBr

Δ**I-3022**

Cyanogen bromide, when heated with absolute ether in a sealed glass tube at 130°–140°C., for 8–10 hours, polymerizes to form a white powder.

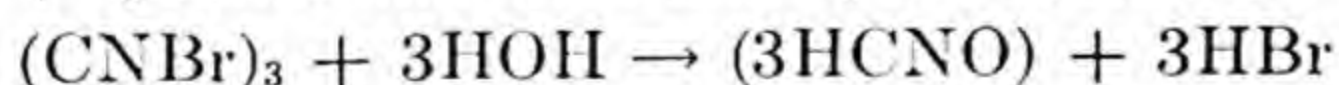


A. Eghis, *Ber.*, **2**, 160 (1869)

11

(CNBr)₃**H₂O****I-3023**

When polymerized cyanogen bromide is heated with water in a sealed tube at 100°C., hydrobromic acid and cyanic acid are formed.

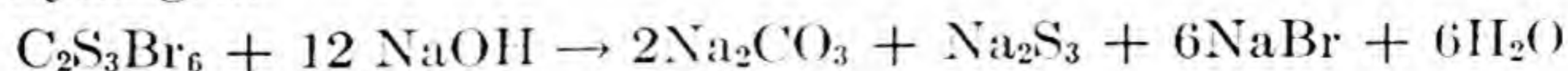


A. Eghis, *Ber.*, **2**, 160 (1869)

11

C₂S₃Br₆**NaOH****I-3024**

Concentrated sodium hydroxide reacts with carbotrithiohexabromide producing sodium carbonate, sodium trisulfide and sodium bromide, at the temperature of the water bath and in the presence of a current of hydrogen.



C. Hell and Uheck, *J. Am. Chem. Soc.*, **4**, 226 (1882)

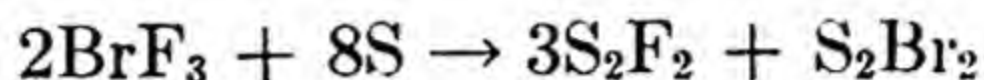
1



S

I-3025

Bromine trifluoride added to melted sulfur forms sulfur monofluoride and sulfur monobromide.



P. Lebeau, *Ann. Chim. Phys.*, [VIII], **9**, 257 (1906)

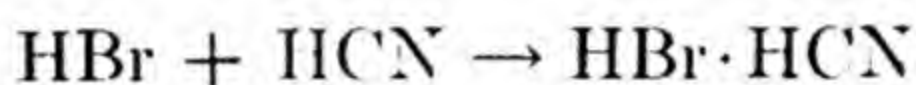
100



HCN

I-3026

When a current of hydrogen bromide which has been carefully dried and freed from bromine is passed into hydrogen cyanide, maintained in the liquid state by means of a refrigerant, most of the gas is absorbed, and on prolonging the reaction long enough, a very light solid mass is obtained. Analysis shows the resulting compound to consist of one molecule of hydrogen bromide combined with one molecule of hydrogen cyanide.



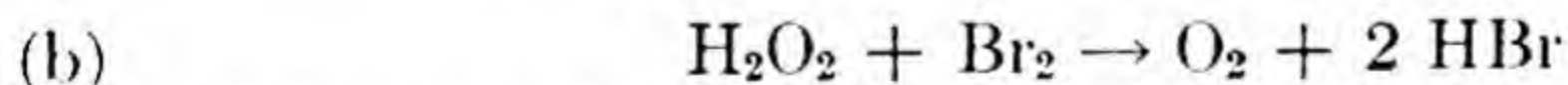
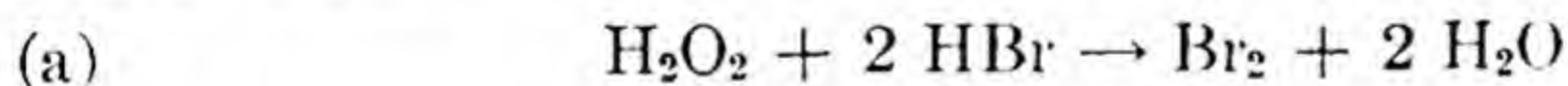
H. Gal, *Compt. Rend.*, **61**, 643 (1865)

29

 H_2O_2

I-3027

The latent photographic image may be intensified by the use of hydrogen peroxide. The following reactions take place when acid and soluble bromide are mixed with H_2O_2 solution.



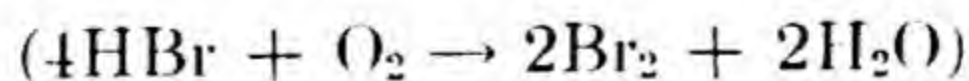
•E. P. Wightman and R. F. Quirk, *Science*, **66**, 92 (1927)

44

 O_2

I-3028

The reaction between hydrogen bromide and oxygen is complete at temperatures above 500°C . At lower temperature it is slow in presence of moisture and negligible if the gases are dry.



M. Berthelot, *Compt. Rend.*, **156**, 687 (1913)

Ref., M. Richardson, *J. Chem. Soc.*, (London) **51**, 801 (1887)

Ref., E. Moles, *J. Chim. phys.*, **14**, 389 (1916)

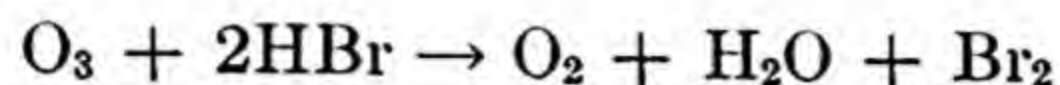
69

HBr

O₃ •

I-3029

Bromine and oxygen are obtained by the reaction of ozone upon hydrobromic acid.



F. P. Treadwell and E. Anneler, *Z. anorg. Chem.*, **48**, 86 (1906)

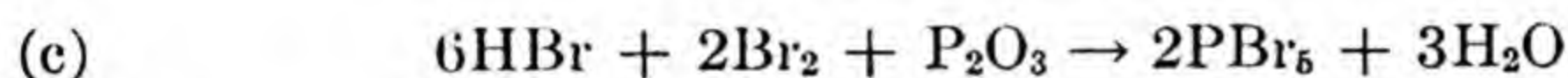
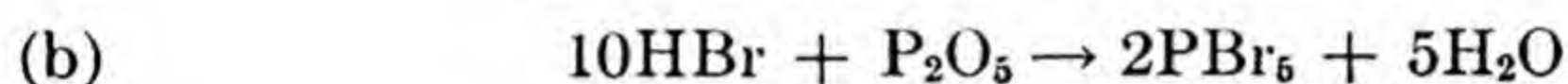
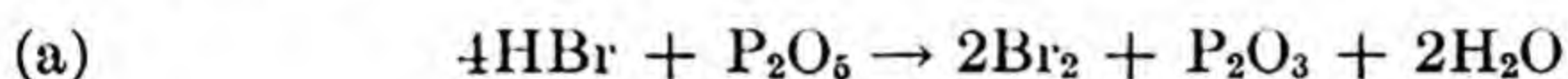
28

HBr

P₂O₅

I-3030

Phosphorus pentoxide reacts with hydrogen bromide and therefore it cannot be used to dry this gas.



E. Moles, *J. Chim. phys.*, **14**, 389 (1916)

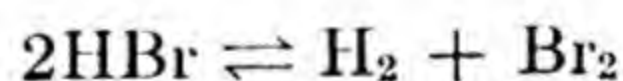
69

HBr

U.V. Light

I-3031

Hydrogen bromide is not decomposed by visible light, but only by ultraviolet light.



D. Berthelot and H. Gaudechon, *Compt. Rend.*, **156**, 687 (1913)
Ref., E. Moles, *J. Chim. phys.*, **14**, 389 (1916)

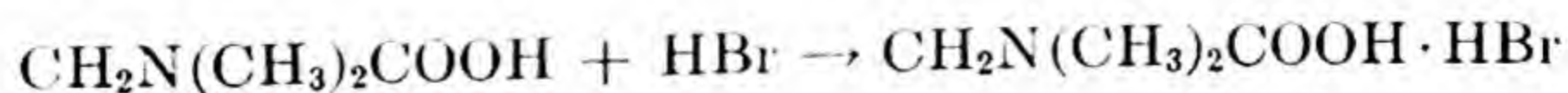
69

HBr

Dimethylaminoacetic acid

I-3032

When an aqueous solution of dimethylaminoacetic acid and excess hydrobromic acid is concentrated, dimethylaminoacetic acid hydrobromide is formed.



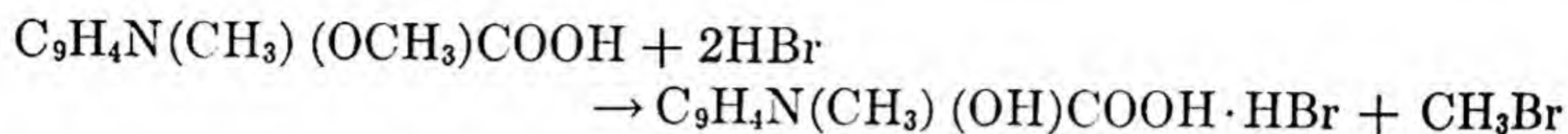
Anslow and King, *Biochem. J.*, **22**, 1258 (1928)

53

HBr

p-Methyl methoxyquinoline-2-carboxylic acid**I-3033**

When p-methyl methoxyquinoline-2-carboxylic acid is refluxed with hydrobromic acid for 4 hours, crystals of the hydrobromide of 6-methyl-kynurenic acid separate.



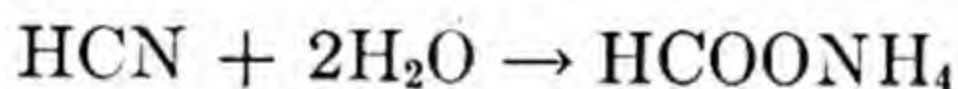
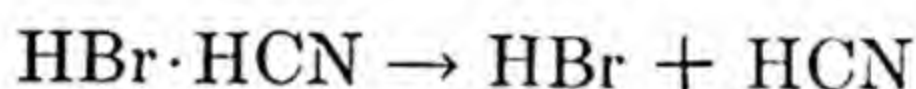
Robson, *Biochem. J.*, **22**, 1162 (1928)

53

HBr·HCN

H₂O**I-3034**

Water decomposes the hydrogen bromide-hydrogen cyanide compound into its constituents. After some time the hydrogen cyanide is transformed into ammonium formate.



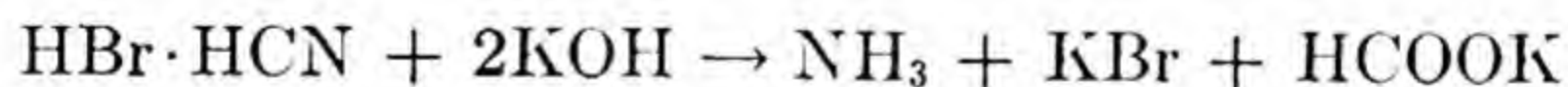
H. Gal, *Compt. Rend.*, **61**, 644 (1865)

29

HBr·HCN

KOH**I-3035**

Potassium hydroxide acts energetically on the hydrogen bromide-hydrogen cyanide compound, giving off ammonia, and forming potassium bromide and formate.



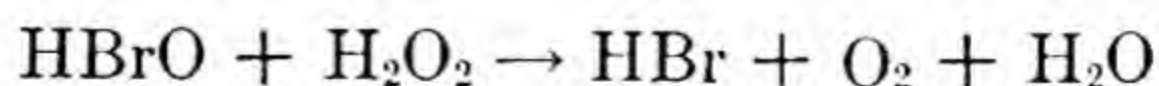
H. Gal, *Compt. Rend.*, **61**, 644 (1865)

29

HBrO

H₂O₂**I-3036**

The amount of hypobromite ion can be determined by adding hydrogen peroxide and titrating the liberated hydrogen bromide.



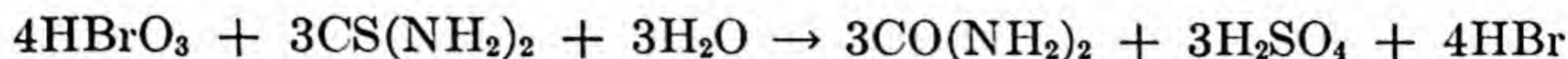
H. Kretzschmar, *Z. Elektrochem.*, **10**, 789 (1904)

86

CS(NH₂)₂

I-3037

Thiocarbamide will be oxidized by bromic acid to urea and sulfuric acid.



L. Szebelledy and W. Madis, *Z. anal. Chem.*, **114**, 253 (1938)

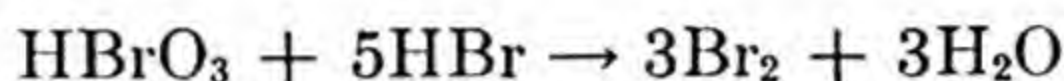
28



HBr

I-3038

The equilibrium of the reaction given below is determined by EMF measurements.



R. Luther and G. V. Sammet, *Z. Elektrochem.*, **11**, 295 (1905)

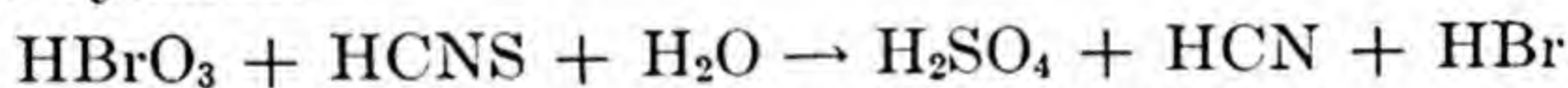
86



HCNS

I-3039

Thiocyanic acid will be oxidized by bromic acid to sulfuric acid and hydrogen cyanide.



L. Szebelledy and W. Madis, *Z. anal. Chem.*, **114**, 343 (1938)

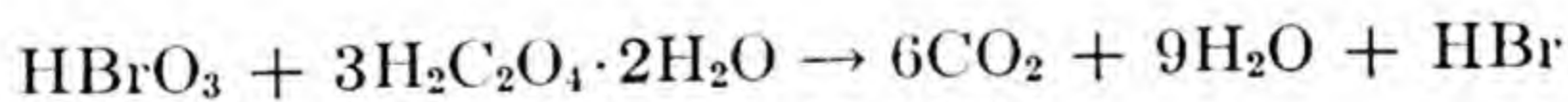
28

H₂C₂O₄·2H₂O

I-3040

H₂SO₄MnSO₄

A solution of oxalic acid in 12% sulfuric acid and 5% manganese sulfate is treated with bromic acid to give carbon dioxide and hydrobromic acid.



L. Debourdeaux, *Ann. Chim. Anal.*, **9**, 167 (1904)

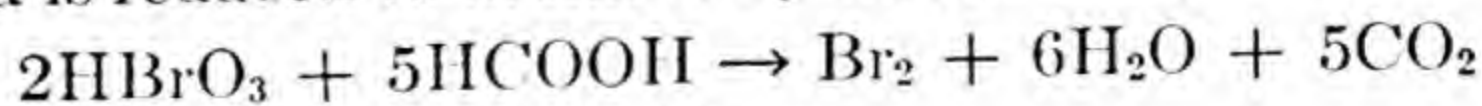
76



HCOOH

I-3041

Bromic acid is reduced to bromine by formic acid.



Rupp and Hartman, *Arch. Pharm.*, **243**, 98

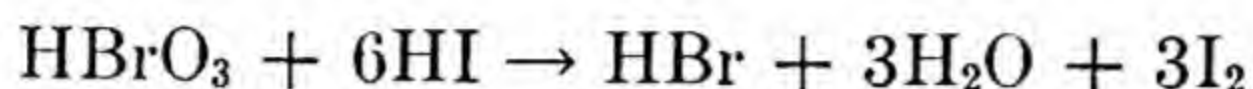
Ref., *J. Am. Chem. Soc.*, **28**, 1742 (1906)

1

HBrO_3

HI **I-3042**

Bromic acid and hydriodic acid in an aqueous solution react to give hydrobromic acid, water and iodine.



G. Magnanini, *Gazz. chim. ital.*, **20**, 377 (1890)

21

HBrO_4

KOH **I-3043**

When an aqueous solution containing the unstable perbromic acid is treated with potassium hydroxide, potassium perbromate is formed with elimination of water.



M. M. Pattison Muir, *J. Chem. Soc.*, **27**, 325 (1874)

48

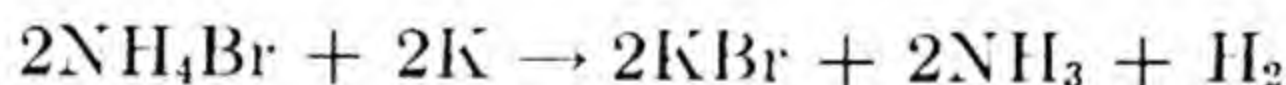
Ref., R. Gerstl, *Ber.*, **7**, 259 (1874)

11

NH_4Br

K **I-3044**

Potassium will reduce ammonium bromide to give potassium bromide, ammonia and free hydrogen.



E. W. Bowerman and W. C. Fernelius, *J. Am. Chem. Soc.*, **61**, 121 (1939)

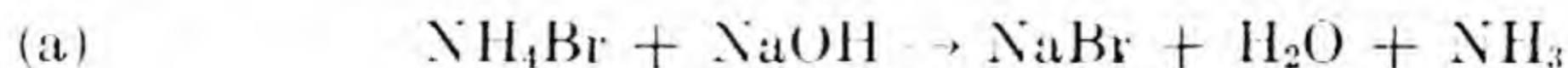
3

NH_4Br

NaOH **I-3045**

H₂SO₄

Ammonium bromide was assayed by dissolving in water and distilling with excess sodium hydroxide into half normal sulfuric acid. Excess acid was then titrated with standard sodium hydroxide using methyl red as indicator.



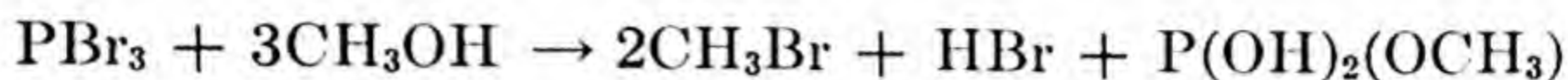
Goldstein and Reindollar, *J. Am. Pharm. Assoc.*, **28**, 85 (1939)

112

CH₃OH

I-3046

Methyl alcohol, when treated with phosphorus tribromide, produces methyl bromide, hydrogen bromide, and monomethylphosphorous acid.



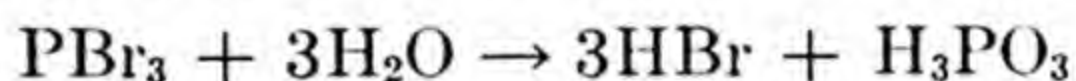
J. W. Walker and F. M. G. Johnson, *J. Chem. Soc. (London)*, **87**, 1594 (1905)

102

H₂O

I-3047

The hydrolysis of phosphorus tribromide is a convenient method for preparing pure hydrogen bromide. In practice bromine is made to react with red phosphorus triturated with water.



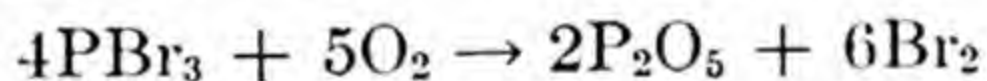
E. Moles, *J. Chim. phys.*, **14**, 389 (1916)

69

O₂

I-3048

Bromine and phosphorus pentoxide are the products of the reaction of a fine stream of oxygen gas upon hot phosphorus tribromide.



A. C. Christomanos, *Z. anorg. Chem.*, **41**, 287 (1904)

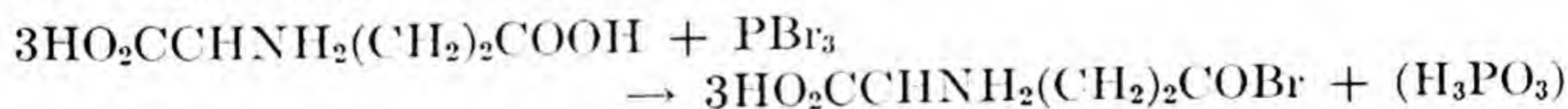
28



Glutaminic acid

I-3049

A mixture of glutaminic acid suspended in toluene and excess PBr₃ forms glutaminyl monobromide when refluxed.



C. P. Stewart and H. E. Tunnicliffe, *Biochem. J.*, **19**, 207 (1925)

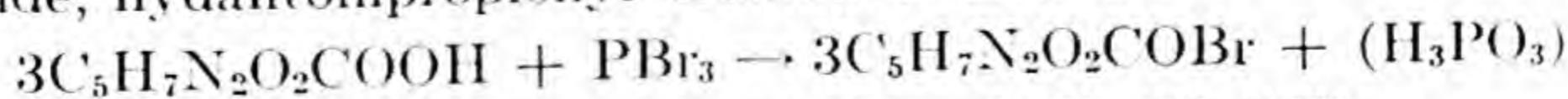
53



Hydantoinpropionic acid

I-3050

When hydantoinpropionic acid is refluxed with excess phosphorus tribromide, hydantoinpropionyl bromide is formed.



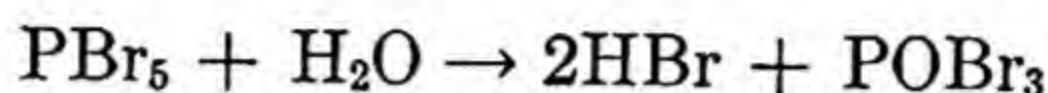
C. P. Stewart and H. E. Tunnicliffe, *Biochem. J.*, **19**, 207 (1925)

53



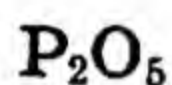
I-3051

Phosphorus oxybromide is not now produced commercially. The only procedure indicated for its preparation consists in the partial hydration of phosphorus pentabromide.



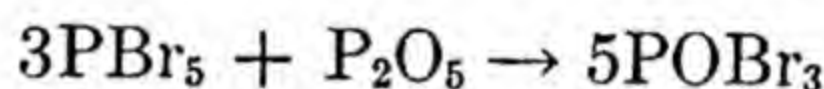
E. Berger, Bull. Soc. Chim. [4] 3, 721 (1908)

31



I-3052

Phosphorus pentabromide is heated in a flask with a small excess of phosphorus pentoxide for 4–5 hours. Distillation and rectification of the crude product gave an 85% yield of phosphorus oxybromide.

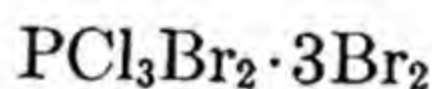


E. Berger, Compt. rend., 146, 400 (1908)

38

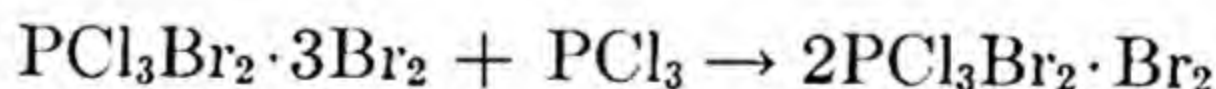
Ref., E. Berger, Bull. Soc. Chim., [4], 3, 721 (1908)

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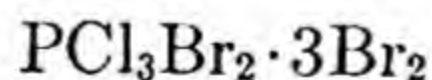
I-3053

When phosphorus trichloride is added to octabromophosphorus trichloride various addition products are formed; when an excess of phosphorus trichloride is added, and a crystal of tetrabromo phosphorus trichloride added, the latter compound crystallizes out.



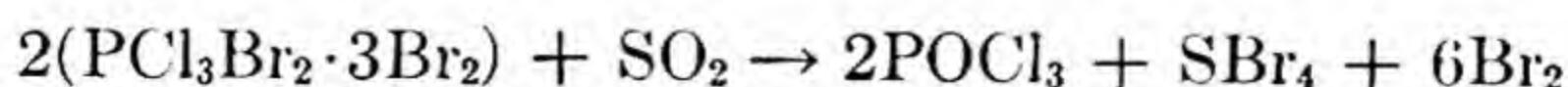
A. Michaelis, Ber., 5, 415 (1872)

11



I-3054

Dry sulfur dioxide reacts slowly with octabromophosphorus trichloride to form phosphorus oxychloride, bromine and sulfur tetrabromide.



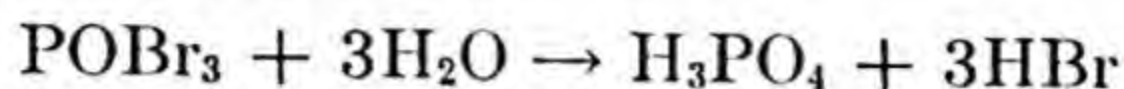
A. Michaelis, Ber., 5, 415 (1872)

11

H₂O

I-3055

Phosphorus oxybromide is decomposed by water to form phosphoric acid and hydrobromic acid.



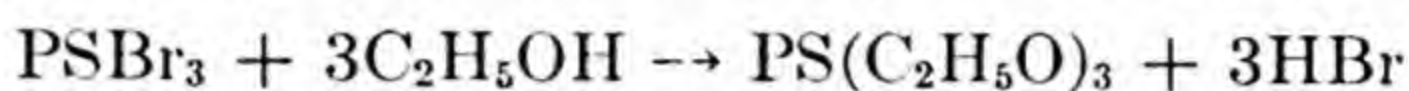
E. Berger, *Compt. rend.*, **146**, 400-1 (1908)

38

C₂H₅OH

I-3056

Ethyl alcohol reacts with phosphorus thiobromide when heated in a sealed tube forming hydrobromic acid and triethoxyphosphorus sulfide.



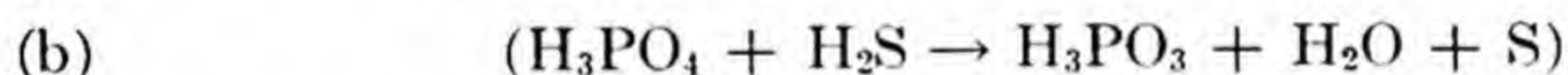
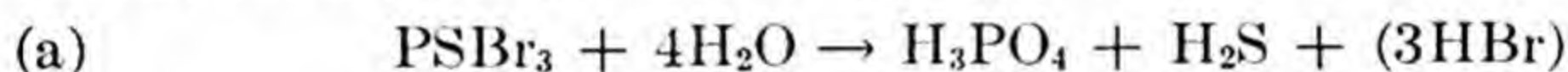
A. Michaelis, *Ber.*, **5**, 4 (1872)

11

H₂O

I-3057

Water slowly decomposes phosphorus thiobromide to form hydrogen sulfide, sulfur, phosphoric and phosphorous acids.



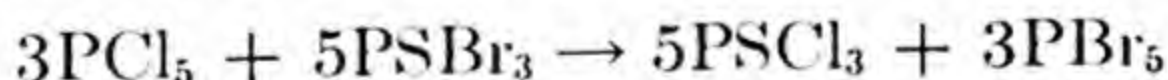
A. Michaelis, *Ber.*, **4**, 777 (1871)

11

PCl₅

I-3058

Phosphorus pentachloride reacts with phosphorus thiobromide to form phosphorus thiochloride and phosphorus pentabromide.



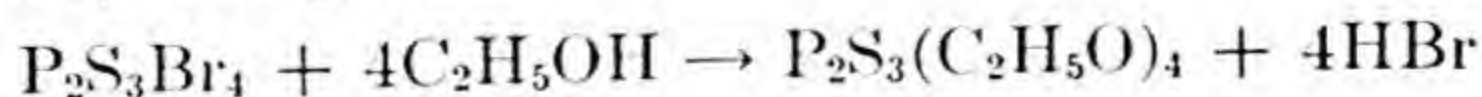
A. Michaelis, *Ber.*, **4**, 777 (1871)

11

C₂H₅OH

I-3059

Ethanol reacts with the bromide of trithiopyrophosphoric acid to form the tetraethoxy compound.



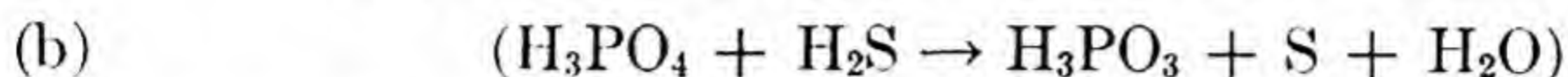
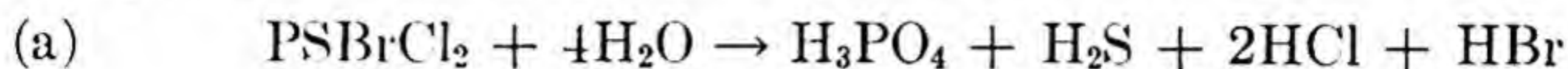
A. Michaelis, *Ber.*, **5**, 9 (1872)

11

PSBrCl₂H₂O

I-3060

Water reacts with phosphorus thiobromo chloride to form phosphoric and phosphorous acids, sulfur, hydrochloric and hydrobromic acids.



A. Michaelis, Ber., 5, 8 (1872)

11

S₂Br₂H₂O

I-3061

Sulfur monobromide when shaken in an excess of cold water decomposes.



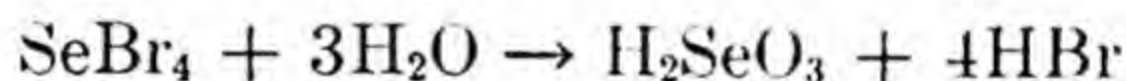
W. Smith, J. Ind. Eng. Chem., 7, 849 (1915)

22

SeBr₄H₂O

I-3062

An excess of cold water decomposes selenium tetrabromide according to the following equation.



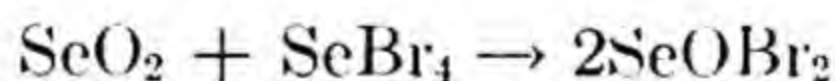
W. Smith, J. Ind. Eng. Chem., 7, 849 (1915)

22

SeBr₄SeO₂

I-3063

Selenium oxybromide is formed when selenium dioxide unites with selenium tetrabromide.



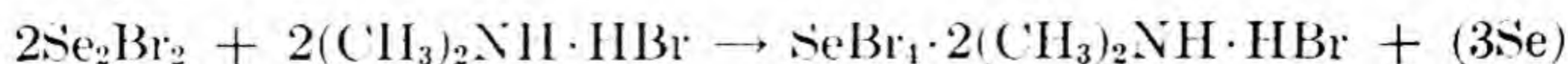
V. Lenher, J. Am. Chem. Soc., 44, 1668 (1922)

1

Se₂Br₂(CH₃)₂NH·HBr

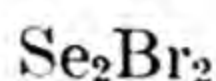
I-3064

Bright red prismatic needles are obtained when a mixture of selenium bromide and dimethylamine hydrobromide, in dilute hydrobromic acid, is evaporated.

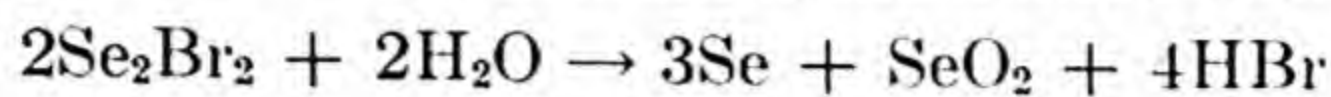


J. F. Norris, Am. Chem. J., 20, 505 (1898)

1

**H₂O****I-3065**

Selenium precipitates when selenium monobromide reacts with water.

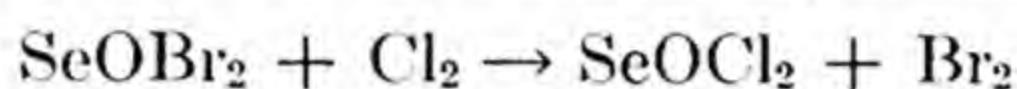


J. F. Norris, *Am. Chem. J.*, **20**, 505 (1898)

1

**Cl₂****I-3066**

Chlorine displaces bromine from selenium oxybromide.

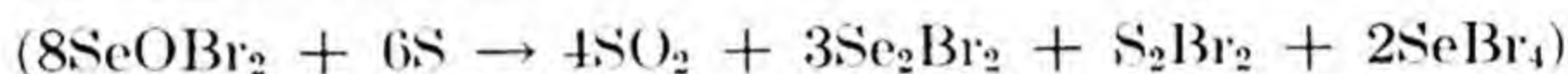


V. Lenher, *J. Am. Chem. Soc.*, **44**, 1669 (1922)

1

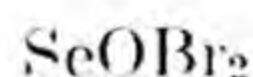
**S****I-3067**

Selenium as well as sulfur react with selenium oxybromide in solution liberating sulfur dioxide.

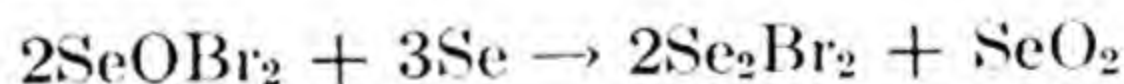


V. Lenher, *J. Am. Chem. Soc.*, **44**, 1669 (1922)

25

**Se****I-3068**

Selenium dissolves a large quantity of selenium oxybromide producing selenium monobromide.



V. Lenher, *J. Am. Chem. Soc.*, **44**, 1669 (1922)

1

**Ag₂O****I-3069**

Silicon tetrabromide is refluxed slowly with silver oxide. It is then dried for twenty-four hours at 75°, two hours at 120°, and one hour at 140°. The dark brown color of the silver oxide slowly disappears, being replaced by the yellow color characteristic of silver bromide, and at the end of thirty hours the process is completed.



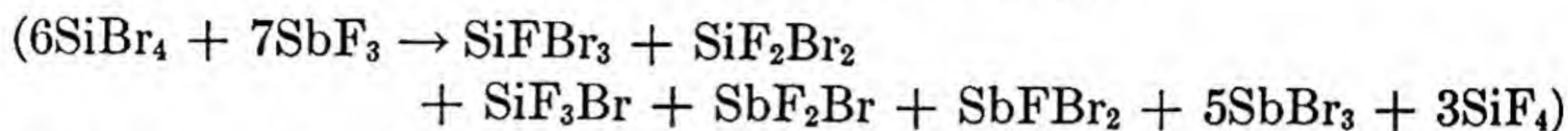
W. C. Schumb and C. H. Klein, *J. Am. Chem. Soc.*, **59**, 261 (1937)

3

SiBr₄SbF₃

I-3070

The fluorination of silicon tetrabromide with antimony trifluoride (without a catalyst) yields all three mixed halides.



W. C. Schumb and H. H. Anderson, J. Am. Chem. Soc., **58**, 994 (1936)

3

SiFBr₃Cl₂

I-3071

Silicon fluorotribromide and chlorine are mixed in a four to three proportion. Heating gently for two hours completes the reaction. Mercury is then introduced into the cooled globe and the free bromine quantitatively removed thereby.



W. C. Schumb and H. H. Anderson, J. Am. Chem. Soc., **59** 651 (1937)

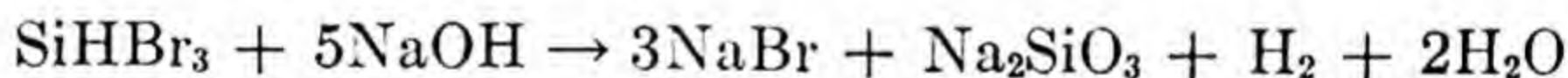
3

SiHBr₃

NaOH

I-3072

Hydrogen is evolved when silicobromoform is treated with a solution of sodium hydroxide.



Schumb and Bickford, J. Am. Chem. Soc., **56**, 853 (1934)

1

SiSBr₂NH₃

I-3073

Silicon thiobromide reacts with liquid ammonia to produce the corresponding amide.



Blix, Ber., **36**, 4219 (1903)

Ref., E. C. Franklin, J. Am. Chem. Soc., **27**, 826 (1905)

1

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Journals Used by Abstractors

Abbreviations used precede the full name of the publication

Acta Acad. Abo.	Acta Academiae Aboensis
Acta Chirurg. Sk.	Acta Chirurgica Scandinavica
Acta Med. Sk.	Acta Medica Scandinavica
Acta Pathol. Micro. Sk.	Acta Pathologica et Microbiologica Scandinavica
Acta Soc. Physiol. Sk.	Acta Societatis Physiologicae Scandinavica
Acta Soc. Sci. fenn.	Acta Societatis scientiarum Fennicae
Acta Univ. Lund.	Acta Universitatis Lundensis
Acta Univ. Lund. Skrifter	Acta Universitatis Lundensis Skrifter
Afhandl. Norsk. Vid. Ak.	Afhandlinger Norske Videnskaps Akademi
Am. Cer. Soc.	Same as J. Am. Cer. Soc.
Am. Chem. J.	American Chemical Journal
Am. Dyestuff R.	American Dyestuff Reporter
Am. J. Sci.	American Journal of Science
An. Asoc. quim. Arg.	Anales de la asociacion quimica Argentina
Anales soc. espan. fis. quim.	Anales de la sociedad española de fisica y quimica
Analyst	Analyst, The
Anal. Ed.	Analytical Edition, Industrial and Engineering Chemistry
Ann.	Annalen der Chemie (Liebig)
Ann. chim.	Annales de chimie
Ann. chim. anal.	Annales de chimie analytique
Ann. de chim. appl.	Annales de chimie analytique et de chimie appliquée
Ann. chim. phys.	Annales de chimie et de physique
Ann. Chem. u. Pharm.	Same as Ann.
Ann. Phys.	Annalen der Physik
Ann. Suppl.	Annalen der Chemie und Pharmacie (Vols. 1-8 Supplement)
Apoth. Zeit.	Apotheker Zeitung
Archiv. Pharm.	Archive der pharmacie
Archiv. méd.	Archives de médecine
Ark. Kem. Min. Geol.	Arkiv för Kemi, Mineralogi och Geologi
Ark. Mat. Astr. Fys.	Arkiv för Matematik, Astronomi och Fysik
Atti. ac. pont. Lincei	Atti dell'accademia pontifica de Nuovi Lincei
Atti. Inst. veneto	Atti dell'Istituto veneto di scienze, lettere ed arti
Avhandl. Fys. Kemi. Min.	Avhandlingar i Fysik, Kemi, och Mineralogi
Ber.	Berichte der deutschen chemischen Gesellschaft
Ber. deuts. pharm. Ges.	Berichte der deutschen pharmazeutischen Gesellschaft
Berg. u. hütten. Ztg.	Berg und hüttenmannische Zeitung
Biochem. J.	Biochemical Journal, The
Biochem. Z.	Biochemische Zeitschrift
Boll. chim. farm.	Bollettino chimico farmaceutico
Brenn. Chem.	Brennstoff-Chemie
Brit. Pat.	British Patent

- B.S. J. Res.
 Bull. Am. Cer. Soc.
 Bull. assoc. chimist.

 Bull. Chem. Soc. (Japan)
 Bull. Geol. Upsala

 Bull. Inst. Phys. & Chem. Res.
 (Tokyo)
 Bull. Nat. Res. C.
 Bull. soc. chim. biol.
 Bull. soc. chim. (Belg.)
 Bull. soc. chim. (France)
 Bull. soc. chim. (Rom.)
 Bull. soc. Mulh.
 Bur. of Chem.
 C.A. (Chem. Abstr.)
 Can. Chem. J.
 Can. Chem. & Met.
 Can. Inst. Min. Met.
 Can. J. Res.
 Can. Min. & Met. Bull.
 Cellulosechemie
 Centr. Min.

 Cereal Chem.
 Chem. Age (L.)
 Chem. Age (N. Y.)
 Chem. Anal.
 Chem. and Ind.
 Chem. Engr.
 Chem. Ind.
 Chemische analyse
 Chemische annalen
 Chemisches Archiv
 Chem. J. Nich.
 Chem. List.
 Chem. & Met. Eng.
 Chem. News
 Chem. Ob.
 Chem. Weekbl.
 Chem. Zbl. (Chem. Zentr.)
 Chem. Zeit.
 Chem. Ztg.
 Chim. et Ind.
 Coll. Czech. Com.

 Compt. rend.

 Dingler's J.
 D.P. (D.R.P.) (Ger. Pat.)

 Bureau of Standards, Journal of Research
 Bulletin of the American Ceramic Society
 Bulletin de l'association des chimistes de sucrerie
 et de distillerie
 Bulletin of the Chemical Society of Japan
 Bulletin of the Geological Institution of the Uni-
 versity of Upsala
 Bulletin of the Institute of Physical and Chemical
 Research (Tokyo)
 Bulletin of the National Research Council
 Bulletin de la société chimique biologique
 Bulletin de la société chimique de Belgique
 Bulletin de la société chimique de France
 Bulletin de société chimique (Roumania)
 Bulletin de la société industrielle Mulhause
 Bureau of Chemistry U. S. Dept. of Agriculture
 Chemical Abstracts
 Canadian Chemical Journal
 Canadian Chemistry and Metallurgy
 Canadian Institute of Mining and Metallurgy
 Canadian Journal of Research
 Canadian Mining and Metallurgical Bulletin
 Cellulosechemie
 Centralblatt für Mineralogie, Geologie u. Palä-
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 Chemical Age (New York)
 Chemist-Analyst
 Chemistry and Industry
 Chemical Engineer
 Chemical Industries
 Chemische Analyse
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 Chemisches Archiv
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 Chemicky Listy pro vedu a promysi
 Chemical and Metallurgical Engineering
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 Chemicky Obzor
 Chemisch Weekblad
 Chemisches Zentralblatt
 Chemische Zeitschrift
 Chemische Zeitung
 Chimie et Industrie
 Collection of Czechoslovak Chemical Communi-
 cations
 Comptes rendus hebdomadaires des séances de
 l'académie des sciences
 Dingler's polytechnisches Journal
 German Patent

Entdeck. Chemie	Entdeckungen in der Chemie
F. Pat.	French Patent
Fuel.	Fuel in Science and Practice
Gazz. chim. ital.	Gazzetta chimica italiana
G. chim. industr.	Giornal de chimica industriale ed applicata
Geol. Fören. För.	Geologiska Förenings Föreläsningar
Helv. Chim.	Helvetica Chimica Acta
Ind. Chim. (Belg.)	Industrie chimique, belge, L'
Ind. Eng. Chem.	Industrial and Engineering Chemistry
Ing. Vet. Akad. Handl.	Ingenjörers Vetenskaps Akademiens Handlingar
Intern. Sugar J.	International Sugar Journal
J. Agr. Res.	Journal of Agricultural Research
J. Am. Cer. Soc.	Journal of the American Ceramic Society
J. Am. Chem. Soc.	Journal of the American Chemical Society
J. Am. Pharm. Assn.	Journal of the American Pharmaceutical Association
J. Anal. & Appl. Chem.	Journal of Analytical and Applied Chemistry
Japan. J. Chem.	Japanese Journal of Chemistry
J. A. O. A. C.	Journal of the Association of Official Agricultural Chemists
Jber. Fortschr. Chem.	Jahresberichte über die Fortschritte der Chemie
Jber. Leist. chem. Technol.	Jahresbericht über die Leistungen der chemischen Technologie
J. Biochem. (Jap.)	Journal of Biochemistry (Japan)
J. Biol. Chem.	Journal of Biological Chemistry
J. Chem. Educ.	Journal of Chemical Education
J. Chem. Pharm.	Journal der Chemie und Pharmacie
J. Chem. Soc. (London)	Journal of the Chemical Society (London)
J. Chem. Soc. (Japan)	Journal of the Chemical Society (Japan)
J. Chim. phys.	Journal de chimie physique
Jern. Ann.	Jernkontorets Annaler
J. f. Chem. Phys. Min.	Journal für Chemie, Physik und Mineralogie (Berlin)
J. f. prakt. Chem.	Journal für praktische Chemie
J. Franklin Inst.	Journal of the Franklin Institute
J. Gen. Chem. (USSR)	Journal of General Chemistry of U.S.S.R.
J. Ind. Eng. Chem.	Journal of Industrial and Engineering Chemistry (Vols. 1 to 14 incl.)
J. Org. Chem.	Journal of Organic Chemistry
J. pharm. chimie	Journal de pharmacie et de chimie
J. Phys. Chem.	Journal of Physical Chemistry
J. Phys. Chem. (USSR)	Journal of Physical Chemistry, U.S.S.R.
J. phys. radium	Journal de physique et le radium, Le
J. f. Prakt. Chem.	Journal für Praktische Chemie
J. Russ. Phys. Chem. Soc.	Journal of the Russian Physical-Chemical Society
J. S. A. Chem. Inst.	Journal of the South African Chemical Institute
J. Soc. Chem. Ind. (London)	Journal of the Society of Chemical Industry (London)
J. Soc. Chem. Ind. (Japan)	Journal of the Society of Chemical Industry (Japan)
J. Soc. Glass Tech.	Journal of the Society of Glass Technology

- J. Wash. Acad. Sc.
 J. & Proc. Austral. Chem. Inst.
 Kolloidchem. Beihefte
 Kolloid-Zeit.
 K. Sven. Vet. Ak. Årsb.
 K. Sven. Vet. Ak. Bih.
 K. Sven. Vet. Ak. Handl.
 K. Sven. Vet. Ak. Över.
 L'Orosi
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 Mem. Coll. Sci. Eng. (Kyoto)
 Mikrochem.
 Mod. Plastics
 Nord. Med. Ark.
 Nova Acta Soc. Uppsal.
 Off. Gaz. U. S. Pat. Office
 Oil & Gas J.
 Oil and Soap
 Over. K. Dan. Vid Sel. Forh.
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 Pharm. J. and Trans.
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 Pharm. Post
 Pharm. Ztg.
 Pogg. Ann.
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 Proc. K. Akad. Wet.
 Proc. Nat. Acad.
 Proc. Roy. Soc. (Edinburgh)
 Proc. Roy. Soc. (London)
 Proc. S. Afr. Ass. Anal. Chem.
 Proc. S. African Chem. Inst.
 Proc. Soc. Chem. Ind. (Victoria)
- Journal of the Washington Academy of Sciences
 Journal and Proceedings of the Australian Chemical Institute
 Kolloidchemische Beihefte
 Kolloid-Zeitschrift
 Kungliga Svenska Vetenskaps Akademiens Årsbok
 Kungliga Svenska Vetenskaps Akademiens Bihang
 Kungliga Svenska Vetenskaps Akademiens Handlingar
 Kungliga Svenska Vetenskaps Akademiens Översigt
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 Meddelanden från Statens Provningsanstalt Stockholm
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 Memoirs of the College of Sciences and Engineering (Kyoto)
 Mikrochemie
 Modern Plastics
 Nordiskt Mediciniskt Arkiv.
 Nova Acta Regiae Societatis Scientarum Uppsaliensis
 Official Gazette of the U. S. Patent Office
 Oil and Gas Journal
 Oil and Soap
 Oversigt over det Kongelige Danske Videnskabsnes Selskabs Forhandlinger
 Pharmaceutical Journal
 Pharmaceutical Journal and Transactions
 Pharmaceutical Magazine
 Pharmazeutische Post
 Pharmazeutische Zeitung
 Poggendorff's Annalen
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 Proceedings of the American Academy of Arts and Sciences
 Proceedings of the Glasgo Philosophical Society
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 Proceedings of the National Academy of Sciences
 Proceedings of the Royal Society (Edinburgh)
 Proceedings of the Royal Society (London)
 Proceedings of the South African Association of Analytical Chemists
 Proceedings of the South African Chemical Institute
 Proceedings of the Society of Chemical Industry (Victoria)

Quart. J. Ind. Chem. Soc.	Quarterly Journal of the Indian Chemical Society
Rec. trav. Chem.	Recueil des travaux chimiques des Pays-Bas
Rend. Acc. Lincei	Rendiconti della R. Accademia dei Lincei
Rev. chim. ind.	Revue de chimie Industrielle
Rev. gen. mat. plast.	Revue general de materie plastique
Revista facultad cienc.	Revista de la facultad de ciencias quimicas (Universidad nacional de La Plata)
Rev. prod. chim.	Revue des produits chimiques, La
Roczniki Chem.	Roczniki Chemji
Russ. Jahrb. Pharm.	Russisches Jahrbuch der Pharmacie
Science	Science, New Series
Sv. Farm. Tidsk.	Svensk Farmaceutisk Tidskrift
Sv. Foto. Tidsk.	Svensk Fotografisk Tidskrift
Sv. Kem. Tidsk.	Svensk Kemisk Tidskrift
Tids. Kemi. Bergvesen	Tidskrift for Kemi og Bergvesen
Trans. Am. El. Chem. Soc.	Transactions of the American Electrochemical Society
Trans. Am. Inst. C. E.	Transactions of the American Institute of Chemical Engineers
Trans. Can. Inst. Min.	Transactions of the Canadian Institute of Mining and Metallurgy
Trans. Faraday Soc.	Transactions of the Faraday Society
Trans. Roy. Soc. (Canada)	Transactions of the Royal Society of Canada
Trans. Roy. Soc. (London)	Transactions of the Royal Society of London
Trans. Roy. Soc. S. Africa	Transactions of the Royal Society of South Africa
U. S. Pat.	United States Patent
Vid. sel. Ch. For.	Videnskabs selskabet Christiania Forhandlinger
Vid. sel. Ch. Skrifter	Videnskabs selskabet Christiania Skrifter
Z. anal. Chem.	Zeitschrift für analytische Chemie
Z. angew. Chem.	Zeitschrift für angewandte Chemie
Z. anorg. Chem.	Zeitschrift für anorganische und allgemeine Chemie
Z. Elektrochem. ang. phys. Chem.	Zeitschrift für Elektrochemie und angewandte physikalische Chemie
Z. f. medic. natur.	Zeitschrift für medicine und naturwissenschaften
Z. Chem. Ind. Koll.	Zeitschrift für Chemie und Industrie der Kolloide
Zeit. f. Chem.	Zeitschrift für Chemie
Zeit. Unters. Lebensm.	Zeitschrift für Untersuchung der Lebensmittel
Z. physik. Chem.	Zeitschrift für physikalische Chemie
Z. physik. chem. Unter.	Zeitschrift für physikalischen und chemischen Unterricht
Z. physiol. Chem.	Zeitschrift für physiologische Chemie (Hoppe Seyler's)

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P₂O₃ \bar{c} As, I-1092
P₂S₃ \bar{c} As, I-1093
P₂S₅ \bar{c} Al, I-155
 \bar{c} As, I-1093
 \bar{c} As₂S₃, I-1469
 \bar{c} SbCl₃, I-841
 \bar{c} SbS₃, I-1005
Pb \bar{c} As, I-1094
Pb(C₂H₃O₂)₂ \bar{c} As₂O₃, I-1371
 \bar{c} H₃As, I-1596
Pb(CNS)₂ \bar{c} AsCl₃, I-1171

PbCl₂ \bar{c} Al, I-156
 \bar{c} As₂S₃, I-1470, I-1471
 \bar{c} H₃AsO₄, I-1707
 \bar{c} Sb₂S₃, I-1006
PbCl₅ \bar{c} AlCl₃, I-276
 \bar{c} Sb₂S₃, I-1006
PbCrO₄ \bar{c} Al, I-157
Pb₃H₄(IO₆)₂ + HCl \bar{c} H₂AsO₃, I-1604
PbI₂ \bar{c} C₆H₅(CH₃)₂C₂H₅AsI, I-1564
Pb(NO₃)₂ \bar{c} Al, I-158
 \bar{c} As(NO₃)₃, I-1262
 \bar{c} H₃AsO₄, I-1708
 \bar{c} K₃AsS₃, I-1752, I-1753
 \bar{c} KH₂AsO₄, I-1785, I-1786
 \bar{c} NaAsO₂, I-1825
 \bar{c} Na₃AsO₄, I-1919
 \bar{c} Na₂HAsO₄, I-2000, I-2001
PbO \bar{c} As₂O₅, I-1421
PbO₂ \bar{c} As₂O₃, I-1372, I-1373
Pb₃O₄ \bar{c} As₂O₅, I-1422
Pb₃O₂(C₂H₃O₂)₂ \bar{c} KH(AsO₂)₂, I-1773
Pb(OH)₂ \bar{c} As₂O₃, I-1374
PbS \bar{c} Al, I-159
 \bar{c} As₂S₃, I-1472
PbSO₄ \bar{c} As₂O₃, I-1320, I-1375
PdCl₂ \bar{c} Ag₃AsO₃, I-1036
 \bar{c} AlCl₃, I-278
 \bar{c} As, I-1078
 \bar{c} (C₂H₅)₃As, I-1513
 \bar{c} (CHCl:CH)₃As, I-1546
PdCl₄ \bar{c} KH(AsO₂)₂, I-1774
PHCH₂C₆H₄N₂Cl + NaOH \bar{c} SbCl₃, I-842
Pt \bar{c} As, I-1095
PtCl₂ \bar{c} As(C₂H₅)₃, I-1126
PtCl₃ \bar{c} As, I-1078
PtCl₄ \bar{c} AlCl₃, I-279
 \bar{c} AsH₃, I-1243
 \bar{c} KH(AsO₂)₂, I-1775

R

RbBr \bar{c} AsBr₃, I-1124, I-1125
 \bar{c} SbI₃, I-918
RbCO₃ \bar{c} As₂O₃, I-1376
RbCl \bar{c} AsCl₃, I-1172
 \bar{c} SbCl₃, I-843, I-844
+ HCl \bar{c} As₂O₃, I-1377
Rb₂F₂ \bar{c} AlF₆·18 H₂O, I-310
RbI \bar{c} AsI₃, I-1254
 \bar{c} SbI₃, I-918
RbNO₃ \bar{c} As₂O₅·6 MoO₃·14H₂O, I-1508

RbOH \bar{c} RbH₂AsO₄, I-2044

Rb₂S₂O₃ \bar{c} SbCl₃, I-832

RhCl₃ \bar{c} As, I-1078

RuCl₃ \bar{c} As, I-1078

S

S \bar{c} Al, I-160, I-161, I-162, I-163, I-164

\bar{c} AlCl₃·SO₂, I-290

\bar{c} AlN, I-342

\bar{c} As, I-1053, I-1096, I-1097

\bar{c} AsI₃, I-1255, I-1256, I-1257

\bar{c} As₂O₃, I-1272, I-1351, I-1378, I-1379

\bar{c} H₃AsO₃, I-1637

\bar{c} K₃AsO₃, I-1736, I-1737

\bar{c} (NH₄)₃AsS₃, I-1804

\bar{c} Na₃AsO₃, I-1903

\bar{c} Sb, I-783

\bar{c} SbF₅, I-894

\bar{c} SbH₃, I-904, I-905, I-906

\bar{c} SbI₃, I-919, I-920

+ C \bar{c} Al₂O₃, I-421

+ I₂ \bar{c} As₂O₃, I-1380

+ NH₄OH \bar{c} As₂O₃, I-1381

+ NaOH \bar{c} Sb₂S₃, I-1007

+ Se \bar{c} Na₃AsO₃, I-1904

S₂Cl₂ \bar{c} AlCl₃, I-280

\bar{c} AlCl₃·SO₂, I-291

\bar{c} AlCl₂·SO₂Cl, I-294

\bar{c} AlN, I-343

\bar{c} Al₂O₃, I-422

\bar{c} As, I-1098, I-1099

\bar{c} As₂O₃, I-1382

\bar{c} As₂O₅, I-1423, I-1424

\bar{c} FeAsS, I-1591

\bar{c} Na₃AsO₃, I-1905

\bar{c} (NiAs)₂, I-2010

\bar{c} NiAsS, I-2016

\bar{c} Sb, I-784, I-785

\bar{c} SbCl₅, I-871

\bar{c} Sb₂O₃, I-966

\bar{c} Sb₂O₅, I-974

\bar{c} Sb₂S₃, I-1008

+ Cl₂ \bar{c} As₂O₃, I-1383

SH·C₂H₄OH \bar{c} Sb₂O₃, I-967

SO₂ \bar{c} AlCl₃, I-281

\bar{c} Na₂CH₃AsO₃, I-1970

\bar{c} Na₂CH₃AsO₃·6H₂O, I-1971

\bar{c} Sb₂O₅, I-975

+ I₂ \bar{c} MgAsC₂H₅O₃, I-1793

SO₃ \bar{c} As₂O₃, I-1321, I-1384

\bar{c} SbCl₅, I-872

SOCl₂ \bar{c} As, I-1100

\bar{c} As₂O₃, I-1385

\bar{c} As₂S₃, I-1473

\bar{c} Sb, I-786

\bar{c} Sb₂O₃, I-968, I-969

\bar{c} Sb₂S₃, I-1009, I-1010, I-1011

SO₂Cl₂ \bar{c} AlCl₃, I-282

\bar{c} As, I-1101

\bar{c} Sb, I-787

SO₂OHCl \bar{c} As, I-1102

Sb \bar{c} AsCl₃, I-1173

\bar{c} As₂O₃, I-1386

\bar{c} As₂S₃, I-1474

\bar{c} SbCl₅, I-873

SbBr₃ \bar{c} AlBr₃, I-199

SbCl₅ \bar{c} AlCl₃, I-283

\bar{c} SbCl₅·C₂H₂, I-878

SbCl₅·C₂H₂ \bar{c} SbCl₅, I-874

SbF₅ \bar{c} AsF₅·NOF, I-1191

SbI₃ \bar{c} C₆H₅(CH)₂As, I-1551

Sb₂O₃ \bar{c} As₂O₃, I-1298

\bar{c} Na₃AsS₄, I-1952

Sb₂S₃ \bar{c} Li₃SbS₃·3H₂O, I-747

Se \bar{c} Al, I-165, I-166

\bar{c} As, I-1103

\bar{c} (CH₃)₃As, I-1104

\bar{c} Sb, I-788

\bar{c} Sb₂, I-1029

\bar{c} SbH₃, I-906

+ KOH \bar{c} As₂Se₃, I-1498

+ NaHS \bar{c} As₂Se₃, I-1491

Se₂Cl₂ \bar{c} Al, I-167, I-168

\bar{c} Al₂Se₃, I-549

\bar{c} As, I-1105

\bar{c} As₂O₃, I-1387

\bar{c} As₂Se₃, I-1492

\bar{c} Sb, I-789

\bar{c} SbCl₃, I-845

SeO₂ \bar{c} (Al₂(SeO₃)₃)₃·(Al(OH)₃)₂(H₂O)₃₃
I-551

Si + Ca \bar{c} Al, I-169

SiCl₄ \bar{c} Al, I-170

\bar{c} As₂O₃, I-1388

\bar{c} SbF₃, I-886

SiHCl₃ \bar{c} AsF₃, I-1186

SiO₂ + KCl \bar{c} Al₂O₃, I-423

\bar{c} AsF₃, I-1187

SiO₂·3CaO \bar{c} Ca₃Al₂O₆, I-577

Sn \bar{c} Al, I-171

\bar{c} As, I-1106, I-1107

\bar{c} As₂O₃, I-1389

\bar{c} Sb, I-790

\bar{c} SbCl₃, I-846

SnCl₂ \bar{c} AsCl₃, I-1174, I-1175

\bar{c} As₂O₃, I-1390

\bar{c} H₃AsO₄, I-1709

\bar{c} KH(AsO₂)₂, I-1776

\bar{c} (NH₄)₃AsO₄·12MoO₃, I-1802

\bar{c} NaAsO₂, I-1826

SnCl₂ + HCl \bar{c} As₂S₃, I-1475

+ HCl \bar{c} As₂S₅, I-1486

SnCl₄ \bar{c} KH(AsO₂)₂, I-1777

\bar{c} NaAsO₂, I-1827

\bar{c} Sb, I-791

+ Al \bar{c} SbCl₅, I-875

SnCl₄·5H₂O + NaOH \bar{c} As₂O₅, I-1425

SnI₄ \bar{c} C₆H₅(CH₃)₂As, I-1552

Sn(OH)₂ + KOH \bar{c} As₂O₃, I-1391

SrCl₂ \bar{c} Al(C₂O₄·NH₄)₂, I-300

SrCl₂ \bar{c} As₂S₅, I-1483

SrCl₂·6H₂O \bar{c} SbBr₃, I-800

SrI₂ \bar{c} H₃AsO₃, I-1642

Sr(NO₃)₂ \bar{c} KH(AsO₂)₂, I-1778

SrO \bar{c} Al, I-172

Sr(OH)₂ \bar{c} Al, I-173

\bar{c} As₂O₅, I-1402, I-1426, I-1427

SrSO₄ \bar{c} Sb₂(SO₄)₃, I-1024

T

Ta₂O₅ \bar{c} AlCl₃, I-284

Te \bar{c} Al, I-174, I-175, I-176

\bar{c} As, I-1108, I-1109, I-1110

TeO₂ \bar{c} AsCl₃, I-1176

TiCl₃ \bar{c} H₃SbO₄, I-720

\bar{c} Na₃AsO₃, I-1906

TiO₂ \bar{c} Al₂O₃, I-424

\bar{c} SbCl₃, I-847

\bar{c} SbCl₅, I-876

TiO₃ \bar{c} AsCl₃, I-1177

TiO(OH) \bar{c} Al, I-178

TiOSO₄ \bar{c} KH(AsO₂)₂, I-1779

TiCl \bar{c} Al, I-177

TiCl₃ \bar{c} (C₆H₅)₃As, I-1521, I-1522

\bar{c} (C₆H₅)₃Sb, I-693

\bar{c} (C₆H₅)₃SbCl₂, I-694

\bar{c} Na₃AsO₃, I-1906

Tl₂S \bar{c} As₂S₅, I-1487

U

UO₃ \bar{c} Al, I-179

U₃O₈ \bar{c} Al, I-180, I-181

UO₂(C₂H₃O₂)₂ \bar{c} H₃AsO₄, I-1710

UO₂(NO₃)₂ \bar{c} KH(AsO₂)₂, I-1780

V

VCl₄ \bar{c} Al, I-182

V₂O₄ + I₂ \bar{c} As₂O₃, I-1392

V₂O₅ \bar{c} Al, I-183

\bar{c} (NH₄)H₂AsO₄, I-1808

W

W \bar{c} As, I-1084

WO₃ \bar{c} Al, I-184

\bar{c} AsH₃, I-1244

Z

Zn \bar{c} Al₂(SO₄)₃, I-538

\bar{c} As, I-1070, I-1111

\bar{c} As₂O₃, I-1393

\bar{c} (CH₃)₂SbBr, I-669

\bar{c} H₃AsO₃, I-1643

\bar{c} H₃AsO₄, I-1711

\bar{c} Sb, I-792

+ H₂SO₄ \bar{c} Ag₃AsO₄, I-1042

Zn(C₃H₇)₂ \bar{c} AsCl₃, I-1178

ZnCO₃ + H₂F₂ \bar{c} Al(OH)₃, I-468

ZnCl₂ \bar{c} Al, I-185

\bar{c} AlCl₃, I-285

\bar{c} As₂O₃, I-1394, I-1395

\bar{c} Na₃SbS₄, I-757

Zn(NO₃)₂ \bar{c} (NH₄)₃AsO₄, I-1801

ZnI₂ \bar{c} H₃AsO₃, I-1643

ZnO \bar{c} Al₂O₃, I-425

\bar{c} As₂O₃, I-1396, I-1397

\bar{c} K₃AsO₄, I-1748

Zn(OH)₂ \bar{c} Al(OH)₃, I-469

ZnS \bar{c} Al₂(SO₄)₃, I-539

ZnSO₄ \bar{c} As₂O₃, I-1398

\bar{c} KH(AsO₂)₂, I-1781

\bar{c} NaAsO₂, I-1828

\bar{c} Na₃AsS₄, I-1953, I-1954

ZrBr₄ \bar{c} Al, I-186

ZrOCl₂ \bar{c} Na₃AsO₄, I-1920

Zr(NO₃)₄ \bar{c} (CH₃)₂N·C₆H₄N₂·C₆H₄AsO₃H₂, I-1571

Heat (Δ)

Δ \bar{c} AgAsS_2 , I-1045
 \bar{c} $\text{Ag}_4\text{As}_2\text{S}_6$, I-1046
 \bar{c} AlAs_3Cl_3 , I-187, I-1047
 \bar{c} Al_2Br_6 , I-202
 \bar{c} $\text{Al}_2\text{Mg}_3(\text{SiO}_4)_3$, I-323
 \bar{c} Al_4C_3 , I-214
 \bar{c} Al_2O_3 , I-427
 \bar{c} $\text{Al}(\text{OH})_3$, I-470
 \bar{c} $\text{Al}_2\text{O}_3 \cdot \text{SiO}_2$, I-473
 \bar{c} Al_2S_3 , I-483
 \bar{c} $\text{Al}_2(\text{SO}_4)_3$, I-540
 \bar{c} As , I-1112, I-1113
 \bar{c} $\text{As}(\text{CNS})_3$, I-1129
 \bar{c} $\text{As}(\text{NH}_2)_3$, I-1260, I-1261
 \bar{c} As_2S_2 , I-1434
 \bar{c} $\text{As}_4\text{S}_6\text{Cl}_2$, I-1507
 \bar{c} $(\text{CHCl}:\text{CH}) \cdot \text{AsO}(\text{OH})_2$, I-1567
 \bar{c} $(\text{CHCl}:\text{CH})_2 \cdot \text{AsO} \cdot \text{OH} \cdot \text{HNO}_3$, I-1570
 \bar{c} $(\text{CH}_3)_3\text{SbBr}_2$, I-665
 \bar{c} $(\text{CH}_3)_2\text{SbBr}_3$, I-670
 \bar{c} $(\text{CH}_3)_2\text{SbCl}_3$, I-676
 \bar{c} $(\text{CH}_3)_3\text{SbCl}_2$, I-677
 \bar{c} $(\text{CH}_3)_3\text{SbCNBr}$, I-680
 \bar{c} $(\text{CH}_3)_2\text{SbI}_3$, I-682
 \bar{c} $\text{Ca}_3(\text{AlO}_3)_2$, I-578
 \bar{c} $(\text{CaO})_3 \cdot \text{Al}_2\text{O}_3 \cdot 6\text{H}_2\text{O}$, I-579
 \bar{c} $\text{Cu}_3(\text{AsO}_4)_2(\text{NH}_3)_3 \cdot 4\text{H}_2\text{O}$, I-1590
 \bar{c} $\text{Cu}_3(\text{AsS}_4)_2$, I-1588
 \bar{c} $\text{H}_6\text{Mn}(\text{AsO}_4)_3 \cdot 3\text{H}_2\text{O}$, I-1722
 \bar{c} H_3SbO_4 , I-721
 \bar{c} $\text{K}_3\text{As}(\text{S}_2\text{O}_3)_3$, I-1756
 \bar{c} $\text{K}_3\text{Sb}(\text{S}_2\text{O}_3)_3$, I-745
 \bar{c} $\text{LiH}(\text{AlO}_2)_2 \cdot 5\text{H}_2\text{O}$, I-624
 \bar{c} $\text{Li}_3\text{SbS}_3 \cdot 3\text{H}_2\text{O}$, I-748
 \bar{c} $\text{Na}_3\text{AsO}_4 \cdot 12\text{H}_2\text{O}$, I-1926
 \bar{c} $\text{Na}_3\text{AsO}_3\text{S}$, I-1938
 \bar{c} $\text{Na}_2\text{CH}_3\text{AsO}_3$, I-1972
 \bar{c} NaSbS_2 , I-752
 \bar{c} $\text{Ni}_3\text{As}_4\text{O}_9$, I-2015
 \bar{c} PbAs_2S_4 , I-2021
 \bar{c} $\text{Pb}_2\text{As}_2\text{S}_6$, I-2036

\bar{c} PbHAsO_4 , I-2034
 \bar{c} PtAsOH , I-2042, I-2043
 \bar{c} $\text{SbBr}_5 \cdot (\text{C}_2\text{H}_5)_2\text{O}$, I-805
 \bar{c} $(\text{SbBrI}_3)\text{Li}$, I-804
 \bar{c} SbCl_5 , I-877
 \bar{c} $\text{SbCl}_6 \cdot \text{C}_2\text{H}_2$, I-879
 \bar{c} Sb_2O_6 , I-976, I-977
 \bar{c} SbOCl , I-979
 \bar{c} $\text{Sb}_2(\text{SO}_4)_3$, I-1025
 \bar{c} $\text{Sn}_3\text{As}_4\text{O}_9$, I-2047
 $+ \text{P } \bar{c} \text{Al}_2\text{Mg}_3(\text{SiO}_4)_3$, I-323

 Electricity (ϵ)

ϵ \bar{c} AlBr_3 , I-200, I-201
 \bar{c} AlCl_3 , I-286, I-287
 \bar{c} As_2O_3 , I-1301
 \bar{c} H_3As , I-1601
 \bar{c} K_2AsO_3 , I-1726
 \bar{c} $2\text{K}(\text{SbO}) \cdot \text{C}_4\text{H}_4\text{O}_6 \cdot \text{H}_2\text{O}$, I-743, I-744
 \bar{c} SbBr_3 , I-801
 \bar{c} SbCl_3 , I-848, I-849, I-850
 \bar{c} SbF_3 , I-887
 \bar{c} SbH_3 , I-907
 \bar{c} SbI_3 , I-921
 \bar{c} Sb_2O_3 , I-970, I-971
 \bar{c} Sb_2S_3 , I-1012
 $+ \text{C } \bar{c} \text{Al}_2\text{O}_3$, I-426
 Air \bar{c} As_2S_2 , I-1438
 \bar{c} KMnAsS_3 , I-1790
 Aqua regia \bar{c} $(\text{NH}_4)_2\text{MoO}_4 \cdot 5\text{MoO}_3 \cdot \text{As}_2\text{O}_5 \cdot 4\text{H}_2\text{O}$, I-1811
 Beta and Gamma Rays \bar{c} H_3As , I-1602
 Decomposition \bar{c} $\text{H}_3\text{AsO}_2\text{S}_2$, I-1714
 \bar{c} $\text{H}_3\text{AsO}_3\text{S}$, I-1716
 \bar{c} Na_3AsOS_3 , I-1930
 \bar{c} $\text{NaH}_2\text{AsO}_3\text{S}$, I-1979
 \bar{c} $\text{Na}_2\text{HAsO}_4 \cdot 12\text{H}_2\text{O}$, I-2004
 Dehydration \bar{c} $2\text{H}_3\text{AsO}_4 \cdot \text{H}_2\text{O}$, I-1718
 \bar{c} $(\text{NH}_4)_3\text{AlO}_3$, I-625
 Light \bar{c} As , I-1114
 $\underline{\text{P}}$ \bar{c} As , I-1058
 Quinine \bar{c} SbBr_3 , I-802
 Vitamin A \bar{c} SbCl_3 , I-851

Reactions under the Elements Ba, Be, Bi, B and Br

A

$\text{Ag } \bar{c} \text{CH}_2\text{Br} \cdot \text{COOH}$, I-2992
 $\text{AgC}_2\text{H}_3\text{O}_2 \bar{c} \text{Ba}(\text{NO}_3)_2$, I-2288
 $\text{AgNCO } \bar{c} \text{BCl}_3$, I-2751

$\text{AgCNS } \bar{c} \text{BBr}_3$, I-2742
 $\text{Ag}_2\text{CO}_3 + \text{HCN } \bar{c} \text{BaCO}_3$, I-2065
 $\text{AgMnO}_4 \bar{c} \text{BaCl}_2$, I-2170
 $\bar{c} \text{BeCl}_2$, I-2574

$\text{AgNO}_3 \bar{c} \text{BaCl}_2$, I-2171
 $\bar{c} \text{Ba(OH)}_2$, I-2343
 $\bar{c} \text{BiH}_3$, I-2636
 $\bar{c} \text{Br}_2$, I-2932
 $\bar{c} \text{CBr}_3\text{COOH}$, I-2961
 $\bar{c} \text{CHBr}_2\text{COOH}$, I-2977
 $\text{Ag}_2\text{O} \bar{c} \text{Br}_2$, I-2933
 $\bar{c} \text{SiBr}_4$, I-3069
 $\text{Ag}_2\text{SO}_4 \bar{c} \text{Br}_2$, I-2934
 $\text{Al} \bar{c} \text{Br}_2$, I-2935
 $\text{AlBr}_3 \bar{c} \text{BF}_3$, I-2772
 $\text{AlCl}_3 \bar{c} \text{BF}_3$, I-2772
 $\text{Al}_2\text{O}_3 \bar{c} \text{BaSO}_4$, I-2421
 $\text{As}_2\text{O}_3 \bar{c} \text{BaS}_2\text{O}_3$, I-2435
 $\text{As}_2\text{O}_5 \bar{c} \text{Be(OH)}_2$, I-2528
 $\text{AuCl}_3 \bar{c} \text{BaO}_2$, I-2316
 $\bar{c} \text{BeCl}_3$, I-2483

B

$\text{B}_2\text{O}_3 \bar{c} \text{BCl}_3$, I-2752
 $\bar{c} \text{B(OC}_2\text{H}_5)_3$, I-2786
 $\text{BaC}_2 \bar{c} \text{BaCO}_3$, I-2066
 $\text{Ba(C}_2\text{H}_5\text{SO}_4)_2 \bar{c} \text{Be}_2(\text{SO}_4)_3$, I-2578
 $\text{BaCO}_3 \bar{c} \text{BaC}_2$, I-2155
 $\bar{c} \text{CBr}_3\text{COOH}$, I-2962
 $\bar{c} \text{CHBr}_2\text{COOH}$, I-2978
 $\bar{c} \text{H}_5\text{BW}_{12}\text{O}_{40}$, I-2871
 $\text{BaCl}_2 \bar{c} \text{BeSO}_4$, I-2558
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 $\text{HC}_2\text{H}_3\text{O}_2 \bar{c} \text{Ba}(\text{OH})_2$, I-2359
 $\bar{c} \text{BeCO}_3$, I-2477
 $\text{H}_2\text{C}_4\text{H}_4\text{O}_6 \bar{c} \text{BeCO}_3$, I-2478
 $\text{H} \cdot \text{CH}_3 \cdot \text{SO}_4 \bar{c} \text{BaCO}_3$, I-2079
 $\bar{c} \text{Ba}(\text{OH})_2$, I-2361
 $\text{HCN} \bar{c} \text{Br}$, I-2928
 $\bar{c} \text{CHBr}_2\text{CHO}$, I-2975
 $\bar{c} \text{HBr}$, I-3026
 $\bar{c} \text{Na}_2\text{B}_4\text{O}_7$, I-2902
 $+ \text{NiSO}_4 \bar{c} \text{BaCO}_3$, I-2080
 $\text{HCNS} \bar{c} \text{Bi}_2(\text{CO}_3)_3$, I-2701
 $\bar{c} \text{Br}$, I-2928
 $\bar{c} \text{HBrO}_3$, I-3039
 $+ \text{KCNS} \bar{c} \text{Bi}_2(\text{CO}_3)_3$, I-2702
 $+ \text{NH}_4\text{CNS} \bar{c} \text{Bi}_2(\text{CO}_3)_3$, I-2702
 $+ \text{NaCNS} \bar{c} \text{Bi}_2(\text{CO}_3)_3$, I-2702
 $\text{H}_2\text{C}_2\text{N}_2\text{S}_3 \bar{c} \text{Ba}(\text{OH})_2$, I-2360
 $\text{H}_2\text{CO}_3 \bar{c} \text{BaO}_2$, I-2326
 $\bar{c} \text{BaPt}(\text{CN})_4$, I-2406

- $\text{H}_2\text{C}_2\text{O}_4 \bar{c} \text{Be}(\text{OH})_2$, I-2530
 $\bar{c} \text{Ba}(\text{NO}_3)_2$, I-2290
 $\bar{c} \text{KBO}_2$, I-2875
 $+ \text{H}_2\text{SO}_4 \bar{c} \text{BiONO}_3$, I-2690
 $\text{H}_2\text{C}_2\text{O}_4 \cdot 2\text{H}_2\text{O} \bar{c} \text{HBrO}_3$, I-3040
 $\text{HCOOH} \bar{c} \text{BaCO}_3$, I-2081
 $\bar{c} \text{BeCO}_3$, I-2476
 $\bar{c} \text{Br}_2$, I-2937
 $\bar{c} (\text{C}_2\text{H}_5)_4 \cdot \text{NBr} \cdot \text{Br}_2$, I-3016
 $\bar{c} \text{HBrO}_3$, I-3041
 $\text{HCl} \bar{c} \text{BN}$, I-2782
 $\bar{c} \text{B}_2\text{O}_3$, I-2806
 $\bar{c} \text{BaFeO}_4$, I-2254, I-2255
 $\bar{c} \text{BaI}_2$, I-2271
 $\bar{c} \text{BaO}_2$, I-2327
 $\bar{c} \text{BaS}$, I-2414
 $\bar{c} \text{BeCO}_3$, I-2479
 $\bar{c} \text{BeO}$, I-2517, I-2518
 $\bar{c} \text{BiCl}_3 \cdot \text{NH}_3$, I-2633
 $\bar{c} \text{BiO}$, I-2676
 $\bar{c} \text{Bi}_2\text{O}_3$, I-2713, I-2714, I-2715
 $\bar{c} \text{Bi}(\text{OH})_2\text{NO}_3$, I-2686
 $\bar{c} \text{BiOI}$, I-2687, I-2688
 $\bar{c} \text{BiS}$, I-2695
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 $\bar{c} \text{Mg}_3\text{B}_2$, I-2883
 $\bar{c} \text{Mg}_3\text{B}_3$, I-2884
 $\bar{c} \text{Na}_2\text{B}_4\text{O}_7$, I-2903
 $\bar{c} \text{Na}_2\text{B}_4\text{O}_7 \cdot 5\text{H}_2\text{O}$, I-2917
 $\text{HClO}_4 \bar{c} \text{BaCl}_2$, I-2181
 $\bar{c} \text{Br}_2$, I-2938
 $+ \text{N}_2\text{H}_4 \cdot \text{H}_2\text{SO}_4 \bar{c} \text{Ba}(\text{OH})_2 \cdot 8\text{H}_2\text{O}$, I-2399
 $\text{H}_2\text{CrO}_4 \bar{c} \text{BeCO}_3$, I-2480
 $\text{HF} \bar{c} \text{B}_2\text{O}_3$, I-2807, I-2808
 $\bar{c} \text{BeO}$, I-2518
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 $\text{H}_2\text{F}_2 \bar{c} \text{H}_3\text{BO}_3$, I-2853
 $\bar{c} \text{Na}_2\text{Ca}_2\text{B}_8\text{O}_{15} \cdot \text{B}_2\text{O}_3$, I-2919
 $\text{H}_2\text{GeO}_3 \bar{c} \text{Ba}(\text{OH})_2$, I-2362
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 $\bar{c} \text{BiOCl}$, I-2680
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 $\bar{c} \text{HBrO}_3$, I-3042
 $\text{HIO}_3 \bar{c} \text{Be}(\text{OH})_2$, I-2532
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 $\bar{c} \text{BaCO}_4$, I-2153
 $\bar{c} \text{BaFeO}_4$, I-2257
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 $\bar{c} \text{Ba}_3\text{N}_2$, I-2758
 $\bar{c} \text{BaO}$, I-2311
 $\bar{c} \text{BaS}$, I-2416
 $\bar{c} \text{BaS}_2\text{O}_8$, I-2445
 $\bar{c} \text{BaSiO}_4$, I-2457
 $\bar{c} \text{BeCl}_2$, I-2486
 $\bar{c} \text{BeCrO}_4 \cdot \text{H}_2\text{O}$, I-2503
 $\bar{c} \text{Be}(\text{OH})(\text{C}_2\text{H}_3\text{O}_2)$, I-2553
 $\bar{c} \text{BiBr}_3$, I-2595
 $\bar{c} \text{BiI}_3$, I-2639, I-2640
 $\bar{c} \text{Bi}(\text{NO}_3)_3$, I-2648
 $\bar{c} \text{Bi}(\text{NO}_3)_3$, I-2658, I-2659, I-2660
 $\bar{c} \text{Br}_2$, I-2939
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 $\bar{c} \text{CCl}_3\text{COBr}$, I-2973
 $\bar{c} \text{CHBr}_2 \cdot \text{CHO}$, I-2976
 $\bar{c} \text{CH}_3\text{COBr}$, I-3001
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 $\bar{c} \text{HBr} \cdot \text{HCN}$, I-3034
 $\bar{c} \text{NaBO}_3$, I-2899
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 $\bar{c} \text{PBr}_3$, I-3047
 $\bar{c} \text{PBr}_5$, I-3051
 $\bar{c} \text{POBr}_3$, I-3055
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\bar{c} S_2Br_2 , I-3061
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 \bar{c} Se_2Br_2 , I-3065
 $+ \text{Na}_5\cdot\text{IO}_6\cdot(\text{MoO}_3)_6$ \bar{c} BaCl_2 , I-2182
 $+ \text{O}_2$ \bar{c} $\text{Bi}(\text{NO}_2)_3$, I-2649, I-2650
 $+ \text{PbO}$ \bar{c} CH_2Br_2 , I-2988
 $+ \Delta$ \bar{c} $(\text{CH}_3\text{COS})_3\text{Bi}$, I-2598
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 \bar{c} $\text{Ba}(\text{OH})_2$, I-2363, I-2364, I-2365
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 \bar{c} HBrO , I-3036
 \bar{c} $\text{LiBO}_2\cdot 8\text{H}_2\text{O}$, I-2878
 $+ \text{NH}_4\text{OH}$ \bar{c} BiONO_3 , I-2691
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 \bar{c} BaO_2 , I-2330
 \bar{c} $\text{Ba}(\text{OH})_2$, I-2366
 \bar{c} BeO , I-2520
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 \bar{c} BiCl_3 , I-2618
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 \bar{c} $\text{Be}(\text{OH})_2$, I-2535
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 \bar{c} $\text{Ba}(\text{ClO}_3)_2$, I-2234
 \bar{c} $\text{Ba}(\text{ClO}_4)_2$, I-2241
 \bar{c} $\text{Ba}(\text{Fe}(\text{CN})_5\text{NO})\cdot 3\text{H}_2\text{O}$, I-2249
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 \bar{c} $\text{BaO}_2\cdot 8\text{H}_2\text{O}$, I-2402
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\bar{c} Bi_2O_4 , I-2723
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 \bar{c} H_3BO_3 , I-2854
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 \bar{c} $\text{Bi}(\text{OH})_3$, I-2683
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 \bar{c} Be , I-2466
 \bar{c} Bi_2S_3 , I-2730
 \bar{c} $\text{K}_2\text{B}_4\text{O}_7$, I-2877
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 $+ \text{H}_2\text{SO}_4$ \bar{c} $\text{Ba}(\text{ClO}_3)_2$, I-2235
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 \bar{c} BF_3 , I-2777
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 KCNO \bar{c} Br_2 , I-2941
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 \bar{c} $\text{Bi}_2(\text{C}_2\text{O}_4)_3$, I-2601
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 $\bar{c} \text{H}_3\text{BO}_3$, I-2855
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 $\text{KMnO}_4 \bar{c} \text{Ba}(\text{OH})_2$, I-2369
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$\bar{c} \text{CHBr}_2\text{NO}_2$, I-2984
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 $\bar{c} \text{Ba}_3(\text{PO}_3)_6$, I-2460
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 $\bar{c} \text{SiSBr}_2$, I-3073
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 $+ \text{NaCl} \bar{c} \text{H}_3\text{BO}_3$, I-2860
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 $\bar{c} \text{Be}(\text{OH})_2$, I-2537
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 $\bar{c} \text{Bi}(\text{NO}_3)_3$, I-2668
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 $\bar{c} \text{Na}_2\text{B}_4\text{O}_7$, I-2910
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$\bar{c} \text{BaS}$, I-2419

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$\bar{c} \text{BiCl}_3$, I-2631

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$\bar{c} \text{Br}_2$, I-2946

$\bar{c} \text{Na}_2\text{Ca}_2\text{B}_8\text{O}_{16} \cdot \text{B}_2\text{O}_3$, I-2920

$\bar{c} \text{PCl}_3\text{Br}_2 \cdot 3\text{Br}_2$, I-3054

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$\bar{c} \text{SeOBr}_2$, I-3068

$\text{SeO}_2 \bar{c} \text{SeBr}_4$, I-3063

$+ \text{H}_2\text{O} \bar{c} (\text{BeSeO}_3)_2 \cdot (\text{BeO})_3 \cdot 10\text{H}_2\text{O}$, I-2580

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V

$\text{V}_2\text{O}_5 \bar{c} \text{Be}(\text{OH})_2$, I-2551

W

$\text{WO}_3 \bar{c} \text{Bi}_2\text{O}_3$, I-2721

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$\text{Zn} \bar{c} \text{CH}_2\text{Br} \cdot \text{CH}_2\text{Br}$, I-2990

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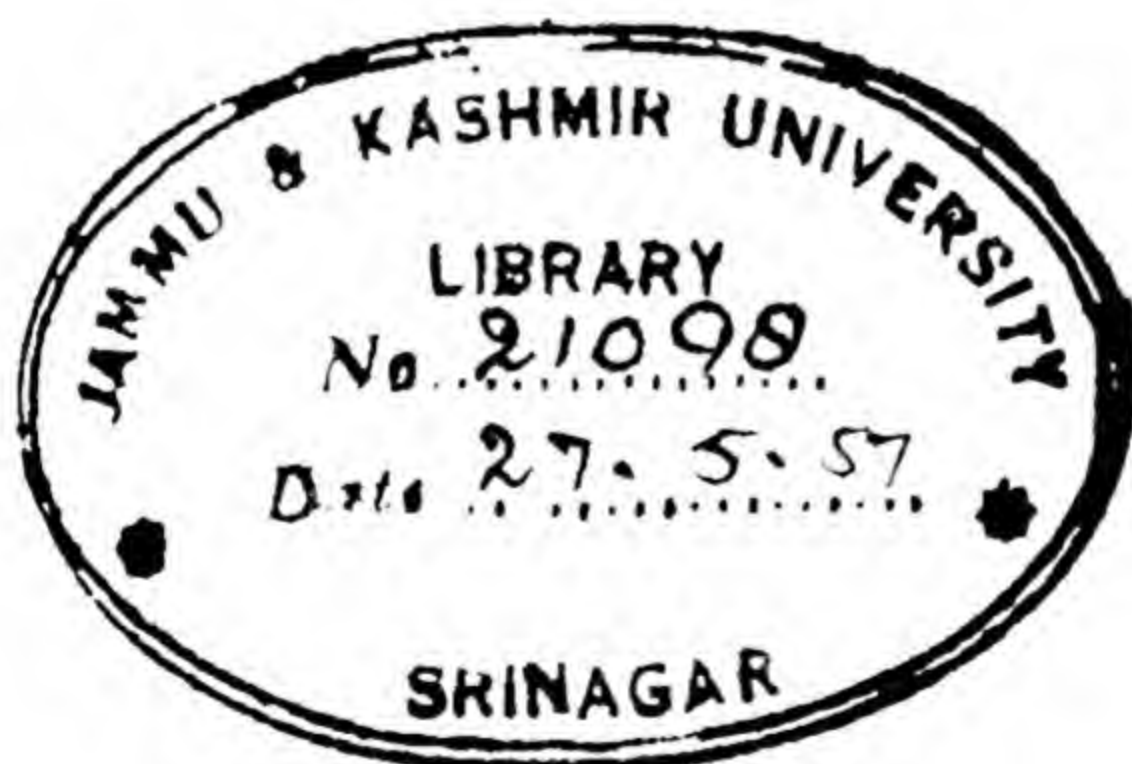
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